ISO 9001:2015 AICTE-CII: GOLD Category Institute NAAC-'A' Grade Institute (CGPA: 3.21) NIRF-2020 Rank Band: 201-250

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रौद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
Estd-1980
KITSW
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

Semester -I Syllabi

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

I SEMESTER

Stream - II

S. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
-	IKSC	U24IK100	AICTE Mandated Student Induction Programme (Universal Human Values - I)						-
1	BSC	U24MH101	Differential Calculus and Ordinary Differential Equations	2	1	-	6	9	3
2	BSC	U24CY102B	Chemistry from Pool - III	2	1	2	5	10	4
3	ESC	U24EC111	Switching Theory and Logic Design	2	1	-	4	7	3
4	ESC	U24AI104	Programming for Problem Solving with C	2	1	2	5	10	4
5	HSMC	U24MH105	English Communication and Report Writing	2	-	-	3	5	2
6	VAC	U24VA106	Sports & Yoga	-	-	2	2	4	1
7	ESC	U24ME107	Engineering Graphics Through CAD	-	-	2	2	4	1
8	ELC	U24EL108	Practicum-I	-	-	-	4	4	1
9	VAC	U24VA109X XXXX	SEA – I / SAA-I	-	-	-	2	2	1
10	AEC	U24AE110	Expert Talk Series-1	-	-	-	1	1	1
			Total:	10	4	8	34	56	21
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				NIL					

Pool – III (Chemistry)		
S. No.	*Course Code*	*Course Title*
1.	*U24CY102A*	*Engineering Chemistry* *(for Mechanical Engineering)*
2.	*U24CY102B*	*Engineering Chemistry* *(Common to CSM, CSD, CSN, CSO & IT)*

DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

Class: B.Tech. I -Semester		**Branch:** Common to all branches	
Course Code:	**U24MH101**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-6-9**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: convergence of an infinite series and differential calculus

LO2: partial differentiation and its applications

LO3: differential equations of first order and first degree along with certain applications

LO4: higher order linear differential equations and applications

UNIT-I	9 Hrs

Infinite Series: Sequences, Series, General properties of series, Series of positive terms, Comparison tests-Limit form, Integral test, D'Alembert's Ratio test, Cauchy's root test

Differential Calculus and its applications: Fundamental theorems-Rolle's theorem (Geometrical interpretation), Lagrange's mean value theorem (Geometrical interpretation), Cauchy's mean value theorem, Taylor's theorem (Generalized mean value theorem), Expansions of functions- Maclaurin's series, Taylor's series, Maxima and Minima-Conditions, Practical problems (rectangle, right circular cylinder, cone)

Self-Learning Topics (SLTs): *Review of basic concepts of limit, continuity and differentiability [Reference 1: topic (3.1,3.2,3.5,4.1)]*

Alternating series [(Text 1: topic 9.12, Solved problems: 9.16,9.17, Practice problems: exercise 9.7(1, 7)]

Additional problems on fundamental theorems [(Text 1: topic 4.3, Solved problems: 4.13(i),4.14,4.17, Practice problems: exercise 4.4 (1(i),1(ii), 3(ii), 10(i), 10(ii))]

Additional problems on Maclaurin's series [(Text 1: topic 4.4, Solved problems: 4.20, Practice problems: exercise 4.5 (3, 5)]

UNIT-II	9 Hrs

Partial differentiation and its applications: Functions of two or more variables, Partial derivatives, Total derivative, Change of variables, Jacobians, Functional relationship, Geometrical Interpretation-Tangent plane and Normal to a surface, Taylor's theorem for function of two variables (without proof), Errors and approximations, Total differential, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers, Differentiation under the integral sign

Self-Learning Topics (SLTs):

Leibnitz rule of Differentiation under the integral sign for variable limits [(Text 1: topic 5.13(2)), Solved problems: 5.54, Practice problems: exercise 5.11 (1)]

Additional problems on maxima and minima of function of two variables [(Text 1: topic 5.11 (1), Solved problems: 5.42, 5.43, Practice problems: exercise 5.10 (1(i),1(ii),1(iii))].

Additional problems on Lagrange's methods of undetermined multipliers [(Text 1: topic (5.12), Solved problems: 5.45, 5.48, Practice problems: exercise 5.10 (3(i) ,3(ii))]

UNIT-III	9 Hrs

Differential equations of first order (DE): Reorientation of differential equation of first order and first degree (Formation a differential equation, variables separable method, homogeneous equations, Linear equations), Exact differential equations, Equations reducible to exact equations,

Applications of differential equations of first order: Orthogonal trajectories - Orthogonal trajectories of the family of curves f(x, y, c)=0, Physical applications-Motion of a boat across a stream, Resisted motion, Velocity of escape from the earth, Simple electric circuits - RL series circuit, Newton's law of cooling, Rate of decay of Radio-active materials, Rate of growth of population

Self-Learning Topics (SLTs): *Review of DEs of first order (Text 1: topic 11.1, 11.2, 11.3, 11.4,11.5)*

Solutions of Non-exact DEs by Inspection Method [(Text 1: topic 11.12(1), Solved Problems: 11.30, Practice problems: exercise 11.8 (1,3)]

Additional problems on Non-exact DEs [(Text 1: topic 11.12(2,3,4,5), Solved problems: 11.33,11.35,11.36, Practice problems: exercise 11.8 (9,15)]

Orthogonal Trajectories of family of curves in polar coordinates [(Text 1: topic 12.3(3), Solved problems :12.7,12.8 , Practice problems: exercise 12.2(9,10)]

UNIT-IV	9 Hrs

Linear differential equations: Linear differential equations with constant coefficients, Rules for finding complementary function, Inverse operator, Rules for finding the particular integral ($Q=e^{ax}$, sin(ax+b) or cos(ax+b), x^m and $e^{ax}V(x)$), Method of variation of parameters, Linear dependence of solutions

Applications of linear differential equations: Simple harmonic motion, Simple pendulum, Oscillations of spring, Oscillatory electrical circuit-LCR circuit, Electro-mechanical analog

Self-Learning Topics (SLTs):

Finding the particular integral of $Q(X)=X^mV(X)$ [(Text 1: topic 13.7, Solved problems: 13.16,13.17,13.19, Practice problems: exercise 13.2 (21,22)].

Additional problems on method of variation of parameters [(Text 1: topic 13.8(1), Solved problems: 13.25, 13.26, Practice problems: exercise 13.3(1,5)]

Cauchy's homogeneous linear differential equation [(Text 1: topic 13.9(1), Solved problems: 13.31,13.34, Practice problems: exercise 13.4(3,6,9)]

Course Learning Outcomes (COs):
After completion of this course, the students should be able to… **CO1**: examine the convergence of a series and interpret mean value theorems. **CO2**: apply partial differentiation to functions of several variables in solving various engineering problems. **CO3**: apply appropriate methods of differential equations of first order and first degree to solve real life engineering problems. **CO4**: analyze the solutions of higher order linear differential equation with constant coefficients
Textbook(s): 1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 44th ed., 2017.
Reference Book(s): 1. Shanti Narayan, Dr. Mittal P.K, *Differential Calculus*, S. Chand & Co., 1st ed., New Delhi, Reprint 2014. 2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John wiely & sons, 10th ed., 2020. 3. S.S. Sastry, *Engineering Mathematics, Vol.II,* Prentice Hall of India, 3rd ed., 2014.
Web and Video link(s): 1. https://youtu.be/4EYko9rdF7g?si=WUu12 *NPTEL Video Lecture on Infinite series by Prof. S.K.Ray, Professor of Mathematics, IITK Kanpur.* 2. https://youtu.be/0apMXhWG_W8?si=M-abw2Gq3buX5HLM *NPTEL Video Lecture on Fundamental mean value theorems by Prof. Jithedra Kumar, Professor of Mathematics, IITK Kharagpur.* 3. https://youtu.be/6r5jfT8xrXM?si=ryLXYVJr4-iUkdlV; *NPTEL Video Lecture on Exact Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur.* 4. https://youtu.be/kbGhrqV9AOM?si=yGyK_V7kJKGa3OaR *NPTEL Video Lecture on Orthogonal Trajectories of family of curves by Prof. Aditya Sharma, Professor of Physics, IISE Bhopal.* 5. *https://youtu.be/btOCUmJkrrg?si=zq3nB00kplm7b5se; NPTEL Video Lecture on Higher Order Linear Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24MH101 DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO1**	**PSO 2**
CO1	**U24MH101.1**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO2	**U24MH101.2**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO3	**U24MH101.3**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO4	**U24MH101.4**	2	2	1	1	-	-	1	1	1	1	1	1	1
U24MH101		**2**	**2**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

ENGINEERING CHEMISTRY

Class: B.Tech. I Semester		**Branches:** CSM, CSD, CSN, CSO& IT	
Course Code:	**U24CY102B**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: electro chemical energy systems, batteries and fuel cells
LO2: water analysis and corrosion with its preventive methods
LO3: engineering materials and spectroscopic techniques of chemical analysis
LO4: polymers, principles of green chemistry and their applications

THEORY COMPONENT

UNIT-I	9 Hrs

Electrochemical Technology and Engineering: Introduction, Specificconductance, Equivalent conductance,Effect of dilution;Conductometrictitrations-Acid base titrations-Strong acid vs strong base, Strong acid vs weak base, Weak acid vs strong base, Weak acid vs weak base,Advantages of conductometric titrations;Galvanic cell, Electrodepotential, Electrochemical series, Nernst equation;Potentiometric titrations-Acidbase titrations and advantages of potentiometric titrations

Batteries: Classification,Lead-acid battery, Li-ion battery

Fuel cells: Hydrogen-oxygen fuel cell

Self Learning Topics (SLTs): *Types of conductors (Text 1: Jain &Jain: chapter 5 topic 1), Ohms law (Text 1: Jain & Jain: chapter 5 topic 5)*

UNIT-II	9 Hrs

Applied Chemistry:

Water Technology: Introduction, Hardness of water, Estimation of hardness of water by complexometry, Alkalinity, Determination of alkalinity, Numerical problems. Determination of dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Softening methods-Ionexchange method, Desalination processes, Reverse osmosis; Quality parameters of potable water (BIS and WHO)

Corrosion: Introduction, Dry corrosion, Pilling-Bedworth rule, Wet corrosion; Factors effecting corrosion-Purity of the metal, Relative areas of anodic and cathodic parts, Nature of surface film, Humidity, pH and Temperature; Prevention methods of corrosion-Cathodicprotection-Impressed current cathodic protection, Sacrificial anodic protection

Self Learning Topics (SLTs): *Units of hardness (Text1: Jain &Jain chapter 1 topic 5), Introduction to corrosion (Text 1: Jain & Jain: chapter 7 topic 1)*

UNIT-III	9 Hrs

Engineering Materials: Nanomaterials-Introduction,Synthesis of nanomaterials-Top down and bottom-up approaches, Synthesis by sol-gel method; Nano scale materials-Fullerenes, Carbon nanotubes and Graphene, Properties and applications, Biosensors

Spectroscopy: Introduction to spectroscopy, Microwavespectroscopy-Principle, Selection rules, Applications; Infra-red spectroscopy-Principle, Selection rules, Applications; UV Spectroscopy-Lambert-Beer's law and itsapplications

Self Learning Topics (SLTs): *Introduction to nanotechnology* **(***Text 1: Jain & Jain:chapter 37 topic 1), Electromagnetic spectrum (Text 1: Jain & Jain; chapter 35 topic 1)*

UNIT-IV	9 Hrs

Polymers: Introduction, Monomer, Polymer, Types of polymerization reactions-Addition and condensation; Preparation, Properties and Applications-Polythene, Polyvinyl cyanide, Polyvinyl chloride, Bakelite, Nylon 6:6; Thermosetting resins and thermoplastic resins; Conducting polymers and their applications

Green Chemistry: Principles of green chemistry, Synthesis of adipic acid by traditional pathway and green pathway; Green methods in electronic production, Impact of electronic waste on environment and public health

Self Learning Topics (SLTs): *Mechanism of addition polymerization (Text 1: Jain &Jain: chapter 3, topic 6); Alternative solvents for green synthesis ((Text 2: Jain &Jain: chapter 36, topic 5)*

LABORATORY COMPONENT

List of Experiments

1. Estimation of hydroxide ion by acidimetry using standard sodium carbonate solution
2. Estimation of alkalinity of water sample containing (i) carbonate; (ii) carbonate & bi carbonate in ground water
3. Estimation of alkalinity of water sample containing (i) bicarbonate; (ii) carbonate & hydroxide in potable water
4. Determination of hardness of water by complexometric method
5. Determination of dissolved oxygen in a sample of water
6. Standardization of sodium hydroxide (NaOH) by conductometry using standard hydrochloric acid (HCl)
7. Standardization of acetic acid (CH_3COOH) by conductometry using standard sodium hydroxide (NaOH)
8. Standardization of strong acid hydrochloric acid (HCl) by potentiometry using standard sodium hydroxide (NaOH)
9. Colorimetric analysis-verification of Lambert-Beer's law
10. Estimation of ferrous (Fe^{2+}) ion in the given solution using potassium permanganate
11. Preparation of nanoparticles of cadmium sulphide (CdS)
12. Synthesis of polymer (phenol- formaldehyde)

Textbook(s):

1. Jain and Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company, 17th ed., 2019 (*chapters 1 ,3 ,5 ,6 ,7 ,35 ,36 ,37)*
2. Dornfeld, D.A., *Green manufacturing: fundamentals and applications,* Springer Science & Business Media, 2012 (*chapters 5, 8, 9)*

Reference Book(s):

1. J.C.Kuriacose and J.Rajaram, *Chemistry in Engineering and Technology*(vol.I), Tata Mc.

Graw-Hills Education Pvt. Ltd., 2010

2. Shashi Chawla, *Text book of Engineering Chemistry*, 3rd ed.,Dhanpat Rai Publishers, 2003
3. S.S. Dara, S.S. Umare, *A Text book of Engineering Chemistry*, 12th ed., S.Chand & Company Ltd.,2010

Web and Video link(s):

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/battery-cell-technology-materials-and-industrial-applications/?v=c86ee0d9d7ed *NPTEL Video Lecture on Battery technology by Dr. Kothandaraman, Professor of Chemistry, IIT Madras &Dr.Raghunathan, Professor of Chemical engineering, IIT Madras*

Laboratory Manual (for laboratory component):

1. *Engineering Chemistry Laboratory manual,* Department of PS, KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on cognitive skills acquired from theory component)

CO1: apply the concepts of electrochemical energy systems for batteries and fuel cells
CO2:interpret suitable techniques of water analysis and corrosion treatment of solid materials
CO3: apprise manufacturing of engineering materials and spectroscopic techniques of chemical analysis
CO4: apprise the synthesis,applications of engineering materials and principles of green chemistry

(based on psychomotor skills acquired from laboratory component)

CO5: determine water quality parameters-alkalinity, hardness
CO6: make use of analytical instruments for chemical analysis
CO7: determine metals present in their ores
CO8: design the synthesis ofnanomaterial and polymer

Course Articulation Matrix (CAM):		**U24CY102B : ENGINEERING CHEMISTRY**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24CY102B.1**	2	-	-	-	1	1	1	1	1	-	1	-	-
CO2	**U24CY102B.2**	2	-	-	-	1	1	1	1	1	-	1	-	-
CO3	**U24CY102B.3**	2	-	-	-	1	1	1	1	1	-	1	-	-
CO4	**U24CY102B.4**	2	-	-	-	1	2	1	1	1	-	1	-	-
CO5	**U24CY102B.5**	2	1	-	-	-	1	1	1	1	-	1	-	-
CO6	**U24CY102B.6**	2	1	-	-	2	1	1	1	1	-	1	-	-
CO7	**U24CY102B.7**	2	1	-	-	-	1	1	1	1	-	1	-	-
CO8	**U24CY102B.8**	2	1	-	-	-	1	1	1	1	-	1	-	-
U24CY102B		**2.00**	**1.00**	**-**	**-**	**1.20**	**1.12**	**1.00**	**1.00**	**1.00**	**-**	**1.00**	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

SWITCHING THEORY AND LOGIC DESIGN

Class: B.Tech. I -Semester		**Branch:** Common to ECE, CSM, CSD	
Course Code:	**U24EC111**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-6-9**	**CIE**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: number system and binary codes, minimization of switching functions.
LO2: combinational circuits design and implementation using logic gates, adders/subtractors, multiplexer and decoders.
LO3: implementation of sequential circuits, counters, registers using flip flops and logic gates.

LO4: finite state machines and its minimization.

UNIT-I	9 Hrs

Number Systems: Review of number systems, binary weighted and non-weighted codes, binary arithmetic, 1's &2's complement subtraction, error detecting and correcting codes, Hamming code.

Boolean Algebra: Postulates and theorems, logic gates and truth tables, representation of switching functions using SOP & POS forms, Karnaugh map representation, minimization using K-Map.

Self Learning Topics (SLTs): *Solved problems (Text1: Prob 1.3), Solved problems (Text2: example problems 1.7, 1.18, 1. 25, 1.25, 1. 36, 1.84, 2.8, 2.28,2.38), Don't care conditions (Text1: topic 3.6), Other two level implementations (Text1: topic 3.8).*

UNIT-II	9 Hrs

Combinational Circuits: Adders– half Adder, full Adder; subtractors-half subtractor, full Subtractor; parallel adder, Carry look ahead adder, Decoders, decoders - BCD to 7 segments, BCD to decimal. Encoders-priority encoder, Multiplexer and Demultiplexer, realization of switching functions using multiplexers and decoders.

Self Learning Topics (SLTs): *decimal adder (Text1: topic 4.6), Priority encoders (Text2: topic 4.22).*

UNIT-III	9 Hrs

Sequential Circuits: Flip Flops - SR, JK, Race Around Condition in JK, JK Master Slave, D and T Flip Flops, Excitation Tables, Conversion from one type of Flip-Flop to another. Shift Registers, Bidirectional Shift Registers, Ring counter and Johnson Counter; Design of Asynchronous and Synchronous Counters (modulo-N).

Self Learning Topics (SLTs): *latches (Text2: topic 6.4.1, 6.4.2), edge triggered Flip-flops (Text2:*

topic 6.4.3), master slave Flip Flops (Text2: topic 6.9)	
UNIT-IV	**9 Hrs**
State minimization: state table, state diagram, state assignment, state minimization, synthesis of synchronous, sequential circuits – sequence detectors. **Finite State Machines:** Mealy and Moore machines – capabilities and limitations of finite state machine, state equivalence and machine minimization- Merger graph and Merger table. ***Self Learning Topics (SLTs):*** *capabilities and limitations of finite state machine (Ref Text3:10.2) simplification of incompletely specified machines (Ref Text3:10.4).*	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: explain number system and binary codes; prove the given Boolean identity and apply minimization techniques to obtain minimal SOP/POS forms of logic functions

CO2: design switching functions using combinational circuits for given application

CO3: develop a sequential circuit using flip flops and logic gates for given specifications

CO4: develop finite state machine with optimum states for given specifications

Text Book(s):

1. M. Moris Mano, *Digital Design*, PHI, New Delhi, 4th edition, 2006. (Chapters 1 to 6).
2. A. Anand Kumar, *Switching Theory & Logic Design*, PHI, 2nd edition, 2014. (Chapters 1 to 4, 6, 7).

Reference Book(s):

1. G.K. Kharate, *Digital Electronics*, Oxford University Press, Hyderabad, 1st edition, 2012.
2. R.P. Jain, *Modern Digital Electronics*, Tata McGraw-Hill, India, 4th edition, 2010.
3. Zvi. Kohavi, *Switching and Finite Automata Theory*, Cambridge University Press, 3rd edition, 2010.
4. Samuel. C. Lee & B.S. Sonde, *Digital Circuits & Logic Design*, PHI, New delhi, 1st edition, 1976.

Web and Video link(s):

1. https://www.youtube.com/watch?v=JmJWpX2ECfI *NPTEL Video Lecture on Error Detection and Correction*
2. https://www.youtube.com/watch?v=BPBiyzc0OBw *NPTEL Video Lecture on K maps*
3. https://www.youtube.com/watch?v=NHydmByCsZQ&t=638s *NPTEL Video Lecture on logic design*
4. https://www.youtube.com/watch?v=5Zstl5d5Byc *NPTEL Video Lecture on Minimization of Finite State Machines.*

Course Articulation Matrix (CAM):				U24EC111 SWITCHING THEORY AND LOGIC DESIGN									
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EC111.1**	3	2	1	-	-	1	1	1	1	1	1	1	1
CO2	**U24EC111.2**	3	2	1	-	-	1	1	1	1	1	1	2	1
CO3	**U24EC111.3**	3	2	2	1	-	2	1	1	1	1	1	2	1
CO4	**U24EC111.4**	3	2	3	3	-	3	1	1	1	1	1	3	1
U24EC111		**3**	**2**	**1.75**	**2**	**-**	**1.75**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PROGRAMMING FOR PROBLEM SOLVING WITH C

Class: B.Tech. I -Semester		**Branch:** common to all branches	
Course Code:	**U24AI104**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: algorithms, flow charts and develop programs with basic constructs

LO2: control structures and array operations

LO3: string operations and modular programming concepts with functions and recursion

LO4: structures, unions, pointers and files in C programming

THEORY COMPONENT

UNIT-I	9 Hrs

Introduction to Programming: Art of programming through algorithms and flowcharts

Overview of C: History of C, Importance of C, Basic structure of C programs

Constants, Variables and Data Types: Character set, C tokens, Declaration of variables, Defining symbolic constants

Managing Input and Output Operations: Reading a character, Writing a character, Formatted input, Formatted output

Operators and Expressions: Arithmetic, Relational, Increment, Decrement, Conditional, Logical, Bit-wise, Special operators, Arithmetic expressions, Evaluation of expressions, Operator precedence and associativity

Self Learning Topics (SLTs): *Components of a computer, concept of hardware and software (Text1: chapter 1), Executing a C program (Text1: chapter 2), Type conversions in expression (Text1: chapter 4) Solved problems (Text1: chapter 2 to chapter 5), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 2 to chapter 5)*

UNIT-II	9 Hrs

Decision Making and Branching: Simple if statement, if-else statement, Nesting of if-else statements, else if ladder, switch statement, Conditional operator, goto statement

Decision Making and Looping: while statement, do-while statement, for statement, Nested loops, Jumps in loops

Arrays: One-dimensional arrays, Declaration of one-dimensional arrays, Initialization of one-dimensional arrays, Linear search, Two-dimensional arrays, Initializing two dimensional arrays, Multi-dimensional arrays

Self Learning Topics (SLTs): *Concise test expressions (Text1: chapter 7) Dynamic arrays (Text1: chapter 8), Solved problems (Text1: chapter 6 to chapter 8), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 6 to chapter 8)*	
UNIT-III	**9 Hrs**
Character Arrays and Strings: Declaring and initializing string variable, Reading strings from terminal, Writing strings to screen, String handling functions, Table of strings **Modular Programming with User Defined Functions:** Need for user-defined functions, Elements of user-defined functions, Definition of functions, Return values and their types, Function calls, Function declaration, Category of functions, Recursion, The scope, visibility and lifetime of variables (storage classes) ***Self Learning Topics (SLTs):*** *Arithmetic operations on characters, comparison of strings (Text1: chapter 9), Nesting of functions, (Text1: chapter 10), Solved problems (Text1: chapter 9 & chapter 10), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 9 & chapter 10).*	
UNIT-IV	**9 Hrs**
Structures and Unions: Defining a structure, Declaring and initializing structure variables, Accessing structure members, Array of structures, Structures within structures, Unions **Pointers:** Understanding pointers, Declaring and initializing pointer variables, Pointer expressions, Pointers and arrays, Pointers and character strings, Pointers to functions, Pointers and structures **File Management in C:** Defining and opening a file, Closing a file, Input and output operations on sequential text files ***Self Learning Topics (SLTs):*** *Operations on individual members (Text1: chapter 11), Chain of pointers, array of pointers (Text1: chapter 12), Random access to files, Command line arguments (Text1: chapter 13). Solved problems (Text1: chapter 11 to chapter 13), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 11 to chapter 13).*	
LABORATORY COMPONENT	
List of Experiments 1. Programs using input output functions, operators (arithmetic, relational and conditional) 2. Programs using operators (bit-wise, logical, increment and decrement) 3. Programs using conditional control structures: if, if-else, nested if 4. Programs using else if ladder, switch and goto statements 5. Programs using loop control structures: while 6. Programs using loop control structures: do-while and for 7. Programs on one dimensional array and two-dimensional arrays 8. Programs on String operations and string handling functions 9. Programs on different types of functions, parameter passing using call-by-value & call-by-address, recursion and storage classes	

10. Programs using structures, unions, pointers to arrays and pointers to strings
11. Programs using array of pointers and pointers to structures
12. Programs on File operations and file handling functions for sequential text files

Text Book(s):

1. Balagurusamy.E, *Programming in ANSI C*, 8th ed., McGraw Hill, 2022

Reference Book(s):

1. Paul Deitel, Harvey Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, 9th ed., Pearson Education Limited, 2022
2. Brian W. Kernighan and Dennis Ritchie, *The C Programming Language*, 2nd ed., Pearson Education India, 2015
3. Reema Thareja, *Programming in C,* 3rd ed., Oxford University Press, 2023
4. Yashavant Kanetkar, *Let Us C,* 19th ed., BPB Publications, 2022
5. A.K.Sharma, *Computer Fundamentals and Programming in C,* 2nd ed., Universities Press, 2018

Web and Video link(s):

1. https://nptel.ac.in/courses/106105171 *NPTEL Video Lecture on Problem Solving through Programming in C by Prof. Anupam Basu, Professor of CSE, IIT Kharagpur.*
2. https://nptel.ac.in/courses/106104128 *NPTEL Video Lecture on Introduction to Programming in C by Prof. Satyadev Nandakumar, Professor of CSE, IIT Kanpur*

Laboratory Manual (for laboratory component):

1. *Programming for Problem Solving with C Laboratory Manual and Record Book,* Department of CSE, KITSW.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: enumerate programming development steps, design an algorithm and draw a flow chart for a given application

CO2: apply logical skills for problem solving using control structures and arrays

CO3: develop string operations and modular programming with functions

CO4: analyse and implement structures, unions, pointers and files in C programming

CO5: develop programs using operators and decision making statements

CO6: apply loops and arrays to develop a program of an application

CO7: implement string operations and develop modular programs using user-defined functions, recursion, and storage classes.

CO8: develop programs using structures, unions, pointers and files

Course Articulation Matrix (CAM):		U24AI104: PROGRAMMING FOR PROBLEM SOLVING WITH C											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24AI104.1	2	1	1	1	-	-	1	1	1	1	2	1	2
CO2	U24AI104.2	2	2	2	1	-	-	1	1	1	1	2	2	2
CO3	U24AI104.3	2	2	3	1	-	-	1	1	1	1	2	2	2
CO4	U24AI104.4	2	2	3	2	-	-	1	1	1	1	2	2	2
CO5	U24AI104.5	1	1	1	1	1	-	1	1	1	1	2	1	2
CO6	U24AI104.6	1	2	2	2	1	-	1	1	1	1	2	2	2
CO7	U24AI104.7	1	2	3	2	1	-	1	1	1	1	2	2	2
CO8	U24AI104.8	1	2	3	2	1	-	1	1	1	1	2	2	2
U24AI104		**1.5**	**1.75**	**2.25**	**1.5**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1.75**	**2**

ENGLISH COMMUNICATION AND REPORT WRITING

Class: B.Tech. I–Semester		**Branch:** Common to all branches	
Course Code:	**U24MH105**	**Credits:**	**2**
Hours/Week (L-T-P-O-E):	**2-0-0-3-5**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basic grammar principles, reading speed, forming new words, making coherent paragraphs and also promoting ethical values for meaningful life.

LO2: speaking or writing correct sentences, writing effective letters and improving their self-worth.

LO3: critical reading ability, writing conclusive reports and additionally inculcating positive thinking.

LO4: abridging varieties of lengthy texts and maintaining emotional balance.

UNIT-I	**9Hrs**

GRAMMAR

- Tenses-Structures-usage-examples-exercises for practice
- Sentence Correction-Correct use of Tenses, Verb forms, Punctuation.

VOCABULARY

- Word formation: Prefixes-Suffixes-Sentence Formation with newly formed words

READING SKILL

- Definition-Sub skills of Reading-Emphasis on Skimming-Purpose- How to skim through the text-Examples, Exercises for practice

WRITING PRACTICES

- Paragraph Writing- Definition-Organizing Principles of paragraphs - Making a paragraph through hints/graphs and pictures-Coherence-Linking Devices-Systematic Development of Ideas
- Paraphrasing-Précising lengthy expressions for clarity and brevity

LIFE SKILLS: Ethical Values and Humanity The Last Leaf: A Short Story by O. Henry

Self Learning Topics (SLTs):

Articles-(Text 2,Unit-II), English Vocabulary (Text 2,Unit-I, Unit-II, Unit-III)

Verb Forms (Reference book 1,Topic :31), Tenses (Reference book 1,Topics: 16,17,18,19) Reported Speech (Reference book 2, Exercises for Practice, Topics : 161-167)

UNIT-II	**9 Hrs**

GRAMMAR

- Tenses-Revision-Exercises for practice

- Subject-Verb Agreement
- Reported Speech-Transformation
- Sentence Correction -Emphasis Concord ,Report Speech, Sentence Structures

VOCABULARY

- Synonyms-Antonyms-Single Word Substitutes-Popular Abbreviations

READING STRATEGY

- Emphasis on Scanning the Text-Purpose-Advantages-Examples, Exercises and Practice through Teamwork

WRITING PRACTICES

- Letter Writing- Effective Letter Writing Techniques-Information Seeking Letters-Job Application Letters- Apology Letters-Explanation to Memos- E-mails-Cover Letters-Resume

LIFE SKILLS: Determination

- How I Became a Public Speaker: An essay by George Bernard Shaw

Self Learning Topics (SLTs): *English Vocabulary (Text 2,Unit-I,Unit-II,Unit-III),Tenses (Reference book 3,Topic-30, Exercises,30.1,30.2,30.3)*

UNIT-III	**9 Hrs**

GRAMMAR

- Tenses-Revision- Exercises for Practice
- Nouns- Prepositions-Adverbs-Adjectives
- Sentence Correction: Correct Use of tenses, nouns, prepositions, adverbs and adjectives

VOCABULARY

- Phrasal Verbs-Technical Words-Latin Words

READING STRATEGY

- Intensive Reading-purpose-Types of Comprehension Questions-Examples, Exercises and Practice through Teamwork

WRITING PRACTICES

- Report Writing-Definition-Purpose-Qualities of a Good Report- Formal and Informal Reports-Report Format-Sample Reports-Exercises
- Emphasis on Technical Reports

LIFE SKILLS: Positive Attitude

- Be the Best of Whatever You Are: A Poem by Douglas Malloch

Self Learning Topics (SLTs):

- *Parts of Speech (Text book 1,Unit-I),Tenses (Reference book 1, Topics-16,17,18,19) Phrasal Verbs (Reference book 3)*

UNIT-IV	**9 Hrs**

GRAMMAR

- Tenses-Revision-Exercises for Practice

- Clauses- Conjunctions-Transformation of Sentences
- Sentence Correction (Based on Parts of Speech)- Clauses- Tenses

VOCABULARY

- Appropriate Use of Words in Communication-Commonly Confused Words

ACTIVE READING and NOTE-MAKING

- Note-Making-Definition-Purpose-Effectiveness

WRITING PRACTICES

- Précis Writing- Definition-Purpose-Uses-Examples and Exercises-Practice through Teamwork
- Preparing Statement of Purpose (SoP)

LIFE SKILLS: Emotional Balance A Poison Tree: Poem by William Blake

Self-Learning Topics (SLTs):

Tenses (Reference book 2, Topics: 152-157))

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply basic grammar principles in speech and writing, read fast, form new words, make coherent paragraphs and adapt the real value of life.

CO2: create effective letters, e-mails, reply to Memos and do the given tasks with confidence.

CO3: analyze the given texts and write clear and unambiguous reports.

CO4: deduct the superfluous information from lengthy text, prepare SoP (Statement of Purpose) effectively and solve critical problems in life with emotional balance.

Text Book(s):

1. Sanjay Kumar & Pushp Lata, *" English Language and Communication Skills for Engineers"* As per the latest AICTE syllabus, Oxford University Press, 1st edition 2018
2. *"Language and Life: A Skill's Approach"* Based on the latest AICTE model curriculum Orient Blackswan Private Limited 2nd Edition 2019.

Reference Book(s):

1. Thomson A.J. , Martinet A.V., "*A Practical English Grammar*", Oxford University Press 3rd Edition 1997
2. Thomson A.J. ,.Martinet A.V, "*A Practical English Grammar*" Exercise 2 , Oxford University Press 3rd Edition 1997
3. Standard Allen W. , "*Living English Structure*", Pearson India Education Pvt Ltd. 5th Edition 2009

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_hs56/preview Technical English for Engineers by Aisha Icbal, IIT Madars
2. https://onlinecourses.swayam2.ac.in/cec21_lg13/preview Indian Writing in English by Dr.Bindu Ann Philip, St Mary's College Trissur

Course Articulation Matrix(CAM):		U24MH105:ENGLISH COMMUNICATION& REPORT WRITING											
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24MH105.1	-	-	-	-	-	1	2	2	2	-	2	-	-
CO2	U24MH105.2	-	-	-	-	-	1	2	2	2	-	2	-	-
CO3	U24MH105.3	-	-	-	-	-	1	2	2	2	-	2	-	-
CO4	U24MH105.4	-	-	-	-	-	1	2	2	2	-	2	-	-
U24MH105		-	-	-	-	-	1	2	2	2	-	2	-	-
3–HIGH,2–MEDIUM,1 –LOW														

SPORTS /YOGA

Class: B.Tech. I -Semester		**Branch:** Common to all branches	
Course Code:	**U24VA106**	**Credits:**	**1**
Hours/Week(L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: Yoga and its Benefits
LO2: various Sports &Games.
LO3: sportsman spirit.
LO4: all round development

Sports and Games

List of Sports and Games

Sl.No.	Game	Sl.No	Game
1	Badminton	7	Volleyball
2	Basketball	8	Cricket
3	Chess	9	Hand Ball
4	Carrom	10	Kabaddi
5	Foot Ball	11	Kho-Kho
6	Table Tennis	12	Yoga Aasanas

Text Book(s):

1. B.K.Chaturvedi,*Rules and Skills of Games and Sports,* Publisher – Goodwill Publishing House, B-9, Rattan Jyoti, 18 Rajendra Place, New Delhi.

Reference Book(s):

1. Dr.Sakure Girish Madhaorao,*Foundation of Physical Education and Sports*, Sports Publication,New Delhi

Web and Video link(s):

Badminton game Video Link :
https://www.youtube.com/watch?v=HucIqi8Lw3E&t=22s
Basket Ball game Video Link :
https://www.youtube.com/watch?v=-tkE2lJoR58
Chess Video Link :
https://www.youtube.com/watch?v=mDw7lgM8ePo
Carrom game Video Link :
https://www.youtube.com/watch?v=z8vvJpNceeg
Football game Video Link :

https://www.youtube.com/watch?v=mXjW78AgGu4
Table Tennis game Video Link :
https://www.youtube.com/watch?v=bLrJGWvWI4U

Volleyball game Video Link :
https://www.youtube.com/watch?v=BJJb3-O0Q1U
Cricket game Video Link :
https://www.youtube.com/watch?v=87hO_Vs3-wQ
Handball game Video Link :
https://www.youtube.com/watch?v=VCa_0USaq8k
Kabaddi game Video Link :
https://www.youtube.com/watch?v=ai1m7ARNyNI
Kho-Kho game Video Link :
https://www.youtube.com/watch?v=P3_z3LKdLdg
Yoga Aasanas Video Link :
https://www.youtube.com/watch?v=e0Q88DUOXjk
https://www.youtube.com/watch?v=JoDKbXEUrvQ

Course Learning Outcomes(COs):

After completion of this course, the student should be able to demonstrate…

CO1: demonstrate physical fitness by performing yoga asanas.

CO2: demonstrate physical fitness through various games & sports events with defined benchmarks.

CO3: demonstrate sportsman spirit and ethics..

CO4: demonstrate physical, psychological, social and emotional balance.

Course Articulation Matrix (CAM):				**U24VA106 : Sports / Yoga**										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24VA106.1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	U24VA106.2	-	-	-	-	-	-	-	1	-	-	-	-	-
CO3	U24VA106.3	-	-	-	-	-	-	2	-	-	-	-	-	-
CO4	U24VA106.4	-	-	-	-	-	-	-	-	1	-	1	-	-
U24VA106		**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**-**	**1**	**-**	**-**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

ENGINEERING GRAPHICS THROUGH CAD

Class: B. Tech. I –Semester		**Branch:** Common to all (except CE & ME)	
Course Code:	**U24ME107**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: AutoCAD commands, projections of points and straight lines

LO2: projection of oblique planes

LO3: projection of solids and sections of solids

LO4: isometric, orthographic projections, simple circuit diagrams and 3D modelling

List of Experiments

1. Importance of Engineering Drawing, principles of engineering drawing, dimensioning; introduction to AutoCAD software-GUI, settings, standard toolbar, toolbars - draw, modify, dimension, properties, design centre and tool palettes
2. Introduction to orthographic projections-Vertical Plane, Horizontal plane; Views-Front view, Top view, and Side view and draw the Projection of points in different quadrants.
3. Draw the Projection of straight lines
4. Draw the Projection of planes
5. Draw the Projection of solids- Simple position(Axis perpendicular to HP or VP)
6. Draw the projections of solids inclined to both the planes
7. Draw the Sections of solids
8. Draw the Orthographic projections of given objects
9. Conversion of isometric view to orthographic projections
10. Draw the Isometric view from the given orthographic views
11. Draw the pictorial view (3D) from the given Isometric view
12. AutoCAD application in Electrical and Electronics circuits

Text Book(s):

1. Bhatt N.D., *Elementary Engineering Drawing*, Charotar Publishing House, Anand, India, 2017.
2. Kulkarni D. M., Rastogi A. P., and Sarkar A., *Engineering Graphics with AutoCAD*, PHI publisher, revised edition, July 2010.

Reference Book(s):

1. Dhananjay A Jolhe, *Engineering Drawing*, Tata Mc Graw- Hill, 2008.
2. Venugopal K. *Engineering Graphics with Auto CAD*, New Age International Publishers Ltd., Hyderabad, 2012.
3. Luzadder W.J and Duff J.M, *Fundamentals of Engineering Drawing*, Prentice-Hall of India, 1995.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_me79/preview *NPTEL video link for* ***Engineering drawing and computer graphics*** *By Prof. Rajaram Lakkaraju, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Engineering Graphics through CAD Laboratory Manual & Record Book*, Dept. of ME, KITSW.

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: draw projections of points and straight lines inclined to one plane with Auto CAD

CO2: develop the projection of planes using Auto CAD

CO3: construct the projection of solids and sections of solids using Auto CAD

CO4: create orthographic, isometric projections and develop the simple electrical, electronic circuit & 3D modelling using Auto CAD

Course Articulation Matrix (CAM): U24ME107 ENGINEERING GRAPHICS THROUGH CAD

CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24ME107.1	2	1	1	-	2	-	1	1	2	1	1	1	1
CO2	U24ME107.2	2	1	1	-	2	-	1	1	2	1	1	1	1
CO3	U24ME107.3	2	1	1	-	2	-	1	1	2	1	1	1	1
CO4	U24ME107.4	2	1	1	-	2	-	1	1	2	1	1	1	1
U24ME107		**2**	**1**	**1**	**-**	**2**	**-**	**1**	**1**	**2**	**1**	**1**	**1**	**1**

PRACTICUM-I

Class: B.Tech. I -Semester	**Branch:** Common to all branches		
Course Code:	**U24EL108**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps

LO2: implementing a project independently by applying knowledge to practice

LO3: preparingwell-documented report and informative PPT

LO4: effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:**In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH101	U24CY102B	U24EC111	U24AI104	U24MH105	U24VA106
Students allotted to different courses	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053

	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : ……….

S.No.	Roll number of the student	Practicum topic allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetableand alsooutside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum

during the semester course work.

(Signature of class teacher)

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process /

system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggestfor addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicumreport should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacheras per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce

ii) he/she fails to submit the report in prescribed format

iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines
Course Learning Outcomes (COs): *After completion of this course, the students should be able to…* **CO1**: synthesize literature survey, identify research gaps anddefine objective & scope of practicum problem **CO2**: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system **CO3**: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum **CO4**: create a video pitch on practicum and make an effective oral presentation using PPTs

Course Articulation Matrix (CAM):		**U24EL108 : PRACTICUM-1**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL108.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL108.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL108.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL108.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL108		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

SOCIAL EMPOWERMENT ACTIVITY-1 / SELF ACCOMPLISHMENT ACTIVITY-1 (SEA-1 /SAA-1)

Class: B.Tech. I Semester	**Branch:** Common to all branches		
Course Code:	**U24VAXYY(SE/SA)ZZZ**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experiencewhicheffectively help individualsdeal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentationthrough PPTs portraying knowledge, skills,qualitiesacquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) isintroduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual andsocial aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses,which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (SelfAccomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student

develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester,through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(a) **Nodal units:**The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i^{2}RE)shall act as nodal units for activities listed under SEA/SAA.

(b) During the semester period, the student has to**acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition& Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. **As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interacteminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders.Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:**The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentationand report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every studentshall, identifiesminimum of4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:***There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counsellor
Total	**100**	**-**

Note:

(a) **Presentation/ Demonstration:**It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**

b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in makinga well-documented report and an effective oral presentationwith PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Text / Reference Book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Articulation Matrix (CAM):		**U24VAXYY(SE/SA)ZZZ - Courses listed under SEA/ SAA**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24VAXYY.1**	-	-	-	-	-	2	2	2	2	2	-	-	-
CO2	**U24VAXYY.2**	-	-	-	-	-	2	2	2	2	2	-	-	-
CO3	**U24VAXYY.3**	-	-	-	-	-	2	2	2	2	2	-	-	-
CO4	**U24VAXYY.4**	-	-	-	-	-	2	2	2	2	2	-	-	-
U24VAXYY		-	-	-	-	-	2	2	2	2	2	-	-	**-**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Course Code: **U24VA XYY(SE/SA)ZZZ**

X represents semester; YYrepresents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

EXPERT TALK SERIES - 1

Class: B.Tech. I -Semester	**Branch:** Common to all branches		
Course Code:	**U24AE110**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice andapplying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented reportportraying the knowledge, skills, qualities acquired and the impact of the learning

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples,is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

But how would you know all this without venturing into the industry?

(a) The answer is Industry**Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(b) Through Industry expert talks students get to know so much more that textbooks don't explain.

(c) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(d) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(e) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(f) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(g) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(h) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(i) ETS enhances your learning in many ways for global opportunities for your career.

(j) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(k) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode**by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs;*duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:**At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:**There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(l) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

ii. **Supplementary Exam:**

(i) Student has to register for ETS supplementary examination if he/she scores less than 40 marksin CIE

(ii) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks(MCQs/FiBs ; *duration: 2Hrs*)on the content covered in ETS lectures.

(iii) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(iv) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of

the expert talks

Course Articulation Matrix (CAM):		U24AE110 : EXPERT TALK SERIES - 1											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AE110**.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	**U24AE110**.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	**U24AE110**.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	**U24AE110**.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE110		**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Semester -II Syllabi

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

II SEMESTER

Stream-II

S. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	BSC	U24MH201	Matrix Theory and Vector Calculus	2	1	-	6	9	3
2	BSC	U24PY202B	Engineering Physics	2	1	2	5	10	4
3	PCC	U24AI203	Computer Architecture and Organization	2	1	-	4	7	3
4	ESC	U24AI204	Data Structures through C	2	1	2	5	10	4
5	ESC	U24EE205B	Basic Electrical Engineering	2	1	2	5	10	4
6	VAC	U24CY206	Environmental Studies	2	-	-	2	4	-
7	AEC	U24AE207	Idea Lab Makerspace	-	-	2	2	4	1
8	SEC	U24SE208	Programming Skill Development (PSD) Lab - 1	-	-	2	2	4	1
9	ELC	U24EL209	Practicum-2	-	-	-	4	4	1
10	VAC	U24VA210X XXXX	SEA-2 / SAA -2	-	-	-	2	2	1
11	AEC	U24AE211	Expert Talk Series-2	-	-	-	1	1	1
			Total:	12	5	10	38	65	23
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				NIL					

Pool – I (Physics)		
S. No.	*Course Code*	*Course Title*
1.	*U24PY202A*	*Engineering Physics* *(for Mechanical Engineering)*
2.	*U24PY202B*	*Engineering Physics* *(Common to CSM, CSD, CSN, CSO & IT)*

Pool – II (Basic Electrical & Electronics Engineering)		
S. No.	*Course Code*	*Course Title*

1.	*U24EE205A*	***Basic Electrical and Electronics Engineering*** *(for Mechanical Engineering)*
2.	*U24EE205B*	***Basic Electrical Engineering*** *(Common to CSM, CSD, CSN, CSO & IT)*

MATRIX THEORY AND VECTOR CALCULUS

Class: B.Tech. II -Semester		**Branch:** Common to all branches	
Course Code:	**U24MH201**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-6-9**	**CIE:**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: various methods of solving system of linear equations and eigen value problems
LO2: double integral, triple integral and their applications
LO3: vector differential calculus and applications
LO4: integration of vector valued functions and applications

UNIT-I	**9 Hrs**

Matrices:

Rank of a Matrix, Elementary transformations of a matrix, Gauss Jordan method of finding the inverse, Normal form of a matrix, Consistency of linear system of equations, System of linear homogenous equations, Eigen values, Eigen vectors, Properties of Eigen values, Cayley Hamilton's theorem, Reduction to diagonal form, Factorization method (LU Decomposition)

Applications of Eigen value problems: Stretching of an elastic membrane, Eigen value problems arising from Markov processes, Eigen value problems arising from population models, Leslie model

Self-Learning Topics (SLTs): *Review of Matrices [Text 1: topics 2.1,2.2,2.3,2.4,2.5]*

PAQ –Normal form [Text 1, topic 2.7(7), Solved problems: 2.26, Practice problems: exercise 2.4 (9,10)]

Additional problems on System of homogeneous and non-homogeneous equations [Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14)]

Additional problems on Eigen values and Eigen vectors [Text 2: topic 8.1, Solved problems: 8.1(1,2), Practice problems: exercise 8.1(4,6)]

Nature of Quadratic form [Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14))

UNIT-II	**9 Hrs**

Multiple Integrals and Beta, Gamma functions:

Double Integrals, change of order of integration, Double Integrals in polar coordinates, Area enclosed by plane curves, Triple integrals, Volumes of solids, Calculation of Mass for a plane lamina, Beta function, Gamma function, Relation between Beta and Gamma functions (without proof).

Self-Learning Topics (SLTs): *Review of integrals [Text 1: topic Appendix VII (1)*

Additional problems on change of order of integration [Text 1: topic 7.2, Solved problems: 7.4,7.6, Practice problems: exercise 7.1 (9,14))

Centre of gravity of a plane lamina [Text 1: topic 7.10, Solved problems 7.34,7.35, Practice problems: exercise 7.6 (9,10)]

Moment of Inertia of plane lamina [Text 1: topic 7.12(1,2), Solved problems: 7.37,7.38, Practice problems: exercise 7.7 (1,4)]

Additional problems on Volume of solids [Text 1: topic 7.6, Solved problem: 7.21, Practice problems: exercise 7.4 (12,25)]

UNIT-III	**9 Hrs**

Vector Calculus and its applications: - Vector Space, Linear dependent and independent vectors, Differentiation of vectors, Curves in space, Tangent, Principal normal, Binormal, Curvature, Torsion, Velocity and acceleration, Scalar and vector point functions, Del applied to scalar point functions - Gradient, Geometrical interpretation, Directional derivative, Del applied to vector point functions -Divergence, Curl, Physical interpretation of divergence, Physical interpretation of curl, Del applied twice to point functions, Del applied to products of point functions, Decomposition of vector valued functions

Self-Learning Topics (SLTs): *Review of vectors [Text 2: topics 9.1, 9.2, 9.3]*

Vector identities [Text 1: topic 8.9, Solved problems: 8.22, 8.23, Practice problems: exercise 8.4 (13,14)]

Additional problems on Directional derivatives [Text 1: topic 8.5(3), Solved problems: 8.13,8.14, Practice problems: exercise 8.3 (4,6,8,9)]

UNIT-IV	**9 Hrs**

Integration of vectors:

Line integral, Surfaces-Surface integral, flux across a surface, Green's theorem in the plane (without proof), Stoke's theorem (Relation between line and surface integrals) (without proof), Volume integral, Gauss divergence theorem (Relation between surface and volume integrals) (without proof), irrotational fields, solenoidal fields

Self-Learning Topics (SLTs): *Additional problems on Green's theorem [Text 1: topic 8.13, Solved problems: 8.33,8.35, Practice problems: exercise 8.8 (1,2,4)]*

Additional problems on Stoke's theorem [Text 1: topics 8.14, Solved problems: 8.39, 8.40, Practice problems: exercise 8.9 (1,2)]

Additional problems on Gauss Divergence theorem [Text 1: topic 8.16, Solved problems: 8.44,8.46, Practice problems: exercise 8.10 (1,2)]

Course Learning Outcomes (COs):

<u>*After completion of this course, the students should be able to*</u>…

CO1: analyze eigen value problems using matrix theory

CO2: apply basic concepts of multiple integrals in evaluating physical quantities of real-life engineering problems

CO3: apply differential operators on vector and scalar point functions

CO4: solve line, surface, volume integrals and correlate these with applications of Green, Stoke and Gauss divergence theorems

<u>Text Book(s):</u>

1. Grewal, B.S., *Higher Engineering Mathematics*, 44th ed., Khanna Publishers, Delhi, 2017 (Chapters 2,7,8)
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, 10th ed., U.K: John Wiely &sons, 2020 (Chapter 8(8.2))

<u>Reference Book(s):</u>

1. Spiegel M, *Vector Analysis* -Schaum's Series, 2nd ed., McGraw Hill, 2017
2. S.S. Sastry, *Engineering Mathematics, Vol.II,* 3rd ed., Prentice Hall of India, 2014
3. Gilbert Strang, *Introduction to Linear Algebra*, 5th ed., Wellesley-Cambridge Press

<u>Web and Video link(s):</u>

1. https://youtu.be/L4crGhtEX14?si=hyjAPgDheJOhXtYZ : *NPTEL Video Lecture on Matrix Analysis with Applications/Dr.S.K.Gupta and Dr.Sanjeev Kumar/IIT Roorkee*
2. https://youtu.be/ksS_yOK1vtk?si=CNNA58OIuszubPiX : *NPTEL Video Lecture on Integral and Vector Calculus./Prof.Hari Shankar Mahato / IIT Kharagpur*

Course Articulation Matrix (CAM):		**U24MH201: MATRIX THEORY AND VECTOR CALCULUS**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24MH201.1**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO2	**U24MH201.2**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO3	**U24MH201.3**	2	2	1	1	-	-	1	1	1	1	1	1	1
CO4	**U24MH201.4**	2	2	1	1	-	-	1	1	1	1	1	1	1
U24MH201		**2**	**2**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

ENGINEERING PHYSICS

Class: B.Tech. II- Semester		**Branch:** Common to CSM, CSD, CSN, CSO & IT	
Course Code:	**U24PY202B**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basic principles, operation of lasers and optical fibers

LO2: fundamental laws of electrostatics and magnetostatics, properties of magnetic and superconducting materials

LO3: basic concepts of quantum mechanics and quantum computing

LO4: semiconductor materials, semiconductor diodes and bipolar junction transistors (BJTs)

THEORY COMPONENT

UNIT-I	**9 Hrs**

Applied Optics and Lasers: Principles of interference, Diffraction phenomena and applications (qualitative), Difference between conventional light and laser, Basic principles and characteristics of lasers, Absorption, Spontaneous and stimulated emission, Population inversion, Pumping methods, Optical resonator; Types of lasers- Ruby laser, He-Ne laser, Diode laser; Applications of lasers

Fiber Optics: Introduction, Total internal reflection, Optical fiber construction, Numerical aperture and acceptance angle, Types of optical fibers - Step index and graded index, Single and multimode, V-number; Power losses in optical fibers - Attenuation, Dispersion, Bending; Fiber optic communication system, Applications of optical fibers – Endoscopy, Fiber optic sensors (temperature and displacement)

Self Learning Topics (SLTs): *Concept of wave and basic concepts- amplitude, wavelength, frequency, phase, phase angle and general wave equation(Text1: topic 1.9), types of waves(Text1: topic 1.10), reflection laws(Text1: topic 1.11).*

UNIT-II	**9 Hrs**

Electrostatics and Magnetostatics: Electric charges, Coulomb's law, Electric field, Electrostatic potential, Computation of electric field and electrostatic potential due to point and line charges; Magnetic field, Magnetic flux density, Biot-Savart's law, Ampere's law, Faraday's law and Lenz's law

Magnetic and Superconducting materials: Introduction, Permeability, Magnetization, Susceptibility, Origin of magnetism, Bohr magneton, Ferro, Antiferro and ferri magnetic materials, Hysteresis, Soft and hard magnetic materials and their applications; superconductivity, Meissner effect, Transition temperature, Isotope effect, Type-I and type-II superconductors, High T_c superconductors, Applications of superconductors

Self Learning Topics (SLTs): *magnetisation, susceptibility & their relations (Text1: topic 41.2), London penetration depth (Text1: topics 42.4.7), Solved problems (Text1: Prob 42.9 to 42.14).*

UNIT-III	**9 Hrs**

Elements of Quantum Mechanics: Wave-particle duality, de-Broglie wavelength, Physical significance of wave function, Schrodinger time-dependent wave equation, Schrodinger time-independent wave equation, Particle in an infinite potential well (one dimension)

Introduction to Quantum Computing: Observables and operators, Expectation values, Expectation values in operator notation, Dirac Bra-Ket notation, Superposition principle, Concept of Quantum bits, Classical versus Quantum computing, Quantum parallelism and Quantum entanglement, Applications of quantum computing

Self Learning Topics (SLTs): *Heisenberg's uncertainty principle (Text1: topics 27.2), Observables and operators (Text1: topics 27.19), Solved problems (Text1: Prob 27.13, Prob 27.17).*

UNIT-IV	**9 Hrs**

Semiconductor Physics: Classification of solids based on energy band theory- Conductors, Semiconductors and insulators, Intrinsic semiconductor- carrier generation and recombination; Extrinsic semiconductors - n-type and p-type (qualitative)

Semiconductor Diodes and Bipolar Junction Transistors (BJTs): Formation of a PN junction, Forward and reverse bias, PN junction diode, Diode current equation, Zener diode, Zener diode as voltage regulator and their V-I characteristics, Light emitting diode (LED), Transistor structure, Representation of NPN and PNP transistors, Transistor action, Transistor configurations- Common base(CB), Common emitter(CE) and Common collector(CC); Corresponding α, β, γ parameters and their relations and transistor as an amplifier

Self Learning Topics (SLTs): *drift & diffusion current (Text2: topic 4.9), diode current equation (Text2: topic 4.15), Solved problems (Text2: Prob 4.17 to 4.21).*

LABORATORY COMPONENT

List of Experiments

1. Linear Measurements using Vernier callipers and screw gauge
2. Determination of slit width using He-Ne laser
3. Determination of wavelength of He-Ne laser using reflection and transmission diffraction grating
4. Determination of dielectric constant of materials using parallel plate capacitor
5. Magnetic hysteresis- B-H curve tracing using CRO
6. Numerical aperture and acceptance angle of an optical fiber
7. Study of V-I characteristics of PN junction diode

8. Study of V-I characteristics of LED
9. Study of common emitter characteristics of NPN transistor
10. Energy band gap of a semiconductor material
11. Determination of thickness of thin sheet using air-wedge method
12. Determination of Planck's constant

Text Book(s):

1. M. Avadhanulu and Kshirsagar, TVS Arun Murthy, *A Text Book of Engineering Physics*, 11th ed., S. Chand & Company Ltd, 2018
2. S Salivahanan, N Suresh Kumar, *Electronic devices and circuits,* Mc Graw Hill , 2017
3. Michael Nielsen and Isaac Chuang, *Quantum Computation and Quantum Information,* Cambridge University Press, 2010

Reference Book(s):

1. Neil Gershenfeld, *Physics of Information Technology*, Cambridge Univ. Press, 1st Edn., 2000
2. V. Rajendran, *Engineering Physics*, Mc Graw Hill Edn., 2013
3. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction,* The MIT Press Cambridge, Massachusetts London, England, 2011
4. R.K. Gaur and S.L.Gupta, *Engineering Physics*, Dhanpath Rai and Sons, 2013
5. David Halliday, Robert Resnick and S Krane, *Physics Volume I&II*, Wiley India Ltd., 5th ed., 2014

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_ph28/preview; NPTEL *video lecture on Concepts in Magnetism and Superconductivity by Prof. Arghya Taraphder IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc24_lw07/preview; *NPTEL video lecture on Introduction to Law on Electricity by Prof. Uday Shankar, IIT Kharagpur*
3. https://onlinecourses.nptel.ac.in/noc24_ph45/preview; *NPTEL Video Lecture on Introduction to LASER - Course by Prof. M. R. Shenoy, IIT Delhi*
4. https://onlinecourses.nptel.ac.in/noc20_ee77/preview; *NPTEL Video Lecture on Semiconductor Devices and Circuits By Prof. Sanjiv Sambandan, IISc Bangalore*
5. https://nptel.ac.in/courses/106106232; *NPTEL Video Lecture on Introduction to Quantum Computing: Quantum Algorithms and Qiskit by Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan, IIT Madras*

Laboratory Manual (for laboratory component):

1. *Engineering Physics Laboratory Manual & Record Book,* Department of PS, KITSW
2. A.K.Katiyar, C.K.Pandey, *Engineering Physics Theory and Practical,* Wiley India Pvt. Ltd, 2nd Edn., 2017

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: evaluate properties of lasers and optical fibre parameters

CO2: calculate the electric field, electric potential, magnetic field and flux density; determine properties of magnetic and superconducting materials

CO3: evaluate the energy values of a particle in an infinite potential well and apply the quantum principles in quantum computing

CO4: analyze V-I characteristics of semiconductor diodes and suggest their applications; determine resistances of transistor biasing circuits

CO5: measure diameter of wire and hollow tubes using Vernier callipers and screw gauge

CO6: determine the width of a narrow slit and wavelength of laser using diffraction phenomenon and numerical aperture of an optical fiber

CO7: calculate the dielectric constant of a material and plot the hysteresis curve of ferromagnetic material

CO8: determine forward voltage and currents from V-I characteristics of semiconductor diodes; identify cut-off, saturation and active regions of NPN transistor

Course Articulation Matrix (CAM):					**U24PY202B : ENGINEERING PHYSICS**									
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24PY202B.1**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO2	**U24PY202B.2**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO3	**U24PY202B.3**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO4	**U24PY202B.4**	2	1	-	-	-	1	1	1	1	1	1	1	1
CO5	**U24PY202B.5**	2	1	-	-	1	1	1	1	2	1	1	1	1
CO6	**U24PY202B.6**	2	1	-	-	1	1	1	1	2	1	1	1	1
CO7	**U24PY202B.7**	2	1	-	-	1	1	1	1	2	1	1	1	1
CO8	**U24PY202B.8**	2	1	-	-	1	1	1	1	2	1	1	1	1
U24PY202B		**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1.5**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

COMPUTER ARCHITECTURE AND ORGANIZATION

Class: B.Tech. II -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI203**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-4-7**	**CIE :**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: functional units of a computer, principle components and instruction set architecture
LO2: processing unit and computation of arithmetic operations
LO3: memory unit and data transfer between processor, memory and I/O

LO4: operations of high-performance computing systems

UNIT-I	9 Hrs

Basic Structure of Computers: Functional units, Basic operational concepts, Performance.

Instruction Set Architecture: Memory locations and addresses, Memory operations, Instructions and instruction sequencing, Instruction formats, Addressing modes, Assembly Language-Assembler directives.

Self Learning Topics (SLTs): *Importance and working of Processors (Text1: topics 1.7), RISC vs CISC processors (Text1: Chapter 2.11)*

UNIT-II	9 Hrs

Basic Processing Unit: Fundamental concepts, Instruction execution, Hardware components, Instruction fetch and execution steps, Control signals, Hard-wired control, CISC-style processors.

Arithmetic: Addition and subtraction of signed numbers, Multiplication of unsigned numbers, Multiplication of signed numbers, Fast multiplication, Integer division, Floating-point numbers and operations.

Self Learning Topics (SLTs): *Fast multiplication (Text1: Chapter 9.5)*

UNIT-III	9 Hrs

The Memory System: Basic concepts, Semiconductor RAM memories-Internal organization of memory chips, Static memories, Dynamic RAMs; Read-only memories, Memory hierarchy, Cache memory mapping functions, Performance considerations, Secondary storage

Input-Output Organization: Input-output interface- I/O bus and interface modules, I/O vs. memory bus, Isolated vs. memory-mapped I/O; Asynchronous data transfer- Strobe control, Handshaking, Asynchronous serial transfer

Self Learning Topics (SLTs): *Read only memories (Text1: Chapter 8.3), Secondary Storage (Text1: Chapter 8.10), I/O vs. memory bus (Text2: Chapter 12.2)*

UNIT-IV	9 Hrs
Modes of Transfer: Modes of transfer, Priority interrupt, Direct memory access, Interconnection standards. **Pipeline and Vector Processing**: Parallel processing, Pipelining, Arithmetic pipeline, Instruction pipeline, Vector processing. **Multi Processors:** Characteristics of multiprocessors, Interconnection structures. ***Self Learning Topics (SLTs):*** *Interconnection standards (Text1: Chapter 7.5), Arithmetic pipeline (Text2: Chapter 10.3)*	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply principles of computer architecture to design and analyze systems, emphasizing functional units, core components, and instruction set architecture

CO2: design and analyze processing units and arithmetic operations, including control mechanisms and computation of various arithmetic functions

CO3: categorize cache memory mapping techniques and examine data transfer mechanisms between the processor, memory, and I/O systems

CO4: analyze different modes of data transfer, classify interconnection structures of multiprocessors, and evaluate concepts of pipelining and vector processing in high-performance computing systems

Text Book(s):

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, *Computer Organization and Embedded Systems*, 6th ed., New Delhi: McGraw-Hill Education, 2012,. *(Chapters 1, 2, 5, 7-9)*
2. M. Morris Mano, *Computer System Architecture*, Revised 3rd ed., New Delhi: Pearson Education, 2019 (Chapters 9, 10, 11, 12, 14)

Reference Book(s):

1. B Ram, Sanjay Kumar, *Computer Fundamentals: Architecture and Organization*, New Age International Publishers, 5th ed., 2018, New Delhi
2. W. Stallings, *Computer Organization and Architecture - Designing for Performance*, 7th ed., New Delhi: Pearson Education, 2009
3. John P. Hayes, *Computer Architecture and Organization*, 3rd ed., New Delhi: McGraw-Hill Education, 1998
4. Vincent P. Heuring, Harry F. Jordan, *Computer Systems Design and Architecture*, 2nd ed., United States: Pearson Education, 2004

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs88/preview, *NPTEL Video Lecture on Instruction Set Architecture and Input-Output System Design by Prof. INDRANIL SENGUPTA, IIT Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc23_cs67/preview, NPTEL *Video Lecture on Pipelining and Cache Memory by Prof. Smruti Ranjan Sarangi, IIT Delhi.*

Course Articulation Matrix (CAM)				U24AI203 : COMPUTER ARCHITECTURE AND ORGANIZATION										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	**U24AI203.1**	2	2	2	1	-	-	1	1	1	1	1	1	1
CO2	**U24AI203.2**	2	2	2	1	-	-	1	1	1	1	1	1	1
CO3	**U24AI203.3**	2	2	2	1	-	-	1	1	1	1	1	2	1
CO4	**U24AI203.4**	2	2	2	1	-	-	1	1	1	1	1	2	1
U24AI203		**2**	**2**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**1.5**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

DATA STRUCTURES THROUGH C

Class: B.Tech. II –Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI204**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: time complexity, space complexity, array operations, and dynamic memory allocation
LO2: stacks and various forms of queues
LO3: various types of linked lists
LO4: various sorting techniques and hashing techniques

THEORY COMPONENT

UNIT-I	9 Hrs

Data Structures: Basic terminology, Classification of data structures, Applications and operations on data structures, Time and space complexity

Arrays: Operations on arrays-traversing an array, Inserting an element in an array, Deleting an element from an array, Searching an element using binary search and their complexities,

Dynamic Memory Allocation: Memory allocation functions, Dynamic memory allocation for single and two dimensional arrays

Self Learning Topics (SLTs): *Three dimensional and n-dimensional arrays (Text1: topics 2.4.3), passing arrays to functions and pointers (Reference1: topics 3.6, 3.7), Practice problems (Text1: Prob 2.3, Reference1: Prob 1,Prob 2,Prob 3,Prob 4)*

UNIT-II	9 Hrs

Stacks: stacks, Array representation of stacks, Operations on a stack–push and pop; Multiple stacks, Applications of stacks- recursion, Fibonacci series, tower of Hanoi, evaluation of expressions (infix to postfix conversion, evaluation of postfix expression)

Queues: queues, Array representation of queues, Double ended queues, Circular queues

Self Learning Topics (SLTs): *Infix to prefix (Reference1: topics 7.7.3), priority Queue(Reference1: 8.4.3), Solved problems (Reference1: Prob 7.7.1, Prob 7.7.2), Practice problems (Text1: Prob 4.5, Prob 4.11, Prob 5.7, Prob 5.9)*

UNIT-III	9 Hrs

Linked Lists: Basic terminologies, Linked list versus arrays, Memory allocation and de-allocation for a linked list, Singly linked list, Circular linked list, Doubly linked list, Circular doubly linked list (linked list operations- traversing, searching, inserting, deleting), Representing stack and queue using linked list

Self Learning Topics (SLTs): *Merging (Text1: topics 3.3), Skiplist (weblink:*

https://www.geeksforgeeks.org/skip-list/), Deallocation strategy(Text1: topic 3.9), Solved problems (Text1: Prob 3.6.1, Prob 3.6.2), Practice problems (Reference1: Prob 5.5, Prob 5.7, Prob 5.9)	
UNIT-IV	**9 Hrs**
Sorting Techniques: Selection sort, Insertion Sort, Shell sort and radix sort, Time complexities of sorting **Hashing:** Hashing techniques, Collision resolution techniques, Closed hashing, Open hashing, Comparison of collision resolution techniques **Self Learning Topics (SLTs):** Two way insertion sort *(Text1: topics 10.3.4), Comparison of sorting techniques(Reference1: topics 14.16) Solved problems (Reference1: Prob 15.5, Prob 15.6, Prob 15.7), Practice problems (Text1: Prob 6.4)*	
LABORATORY COMPONENT	

List of Experiments

Experiment-I

1. Program to implement initialization of array and perform traversal operations in both the directions
2. Program to implement searching operation on array using Linear Search
3. Program to display the count of occurrences of every number in an array

Experiment-II

4. Program to implement searching operation on array using Binary Search
5. Program to implement insertion operation on array
6. Program to implement deletion operations on array

Experiment-III

7. Program to implement initialization of arrays and traversal operation with DMA
8. Program to implement matrix addition and subtraction with DMA

Experiment-IV

9. Program to implement matrix multiplication with DMA
10. Program to implement stack operations
11. Program to convert infix expression into postfix

Experiment-V

12. Program to evaluate given postfix expression
13. Program to define recursive function to solve tower of hanoi puzzle
14. Program to display the Fibonacci series with the help of recursive function
15. Program to implement MultiStack

Experiment-VI

16. Program to implement queue operations using arrays
17. Program to implement circular queue operations using arrays
18. Program to implement double ended queue operations using arrays

Experiment-VII

19. Program to create single linked list and implement its operations
    Note:- Linked list Operations: i) traversing ii) inserting iii) deleting iv) searching v) reversing vi) concatenation

Experiment-VIII

20. Program to create circular linked list and implement its operations
21. Program to create double linked list and implement its operations

Experiment-IX

22. Program to create circular double linked list and implement its operations

Experiment-X

23. Program to implement stack operations using linked list
24. Program to implement queue operations using linked list

Experiment-XI

25. Program to implement selection sort
26. Program to implement insertion sort

Experiment-XII

27. Program to implement shell sort
28. Program to implement radix sort
29. Program to implement hash table.

Text Book(s):

1. Debasis Samanta, *Classic Data Structures*, 2nd ed., Prentice Hall India, 2009

Reference Book(s):

1. Reema Thareja, *Data Structures Using C*, 2nd ed., Oxford University Press, 2014
2. Balagurusamy E, *Data Structure Using C*, 1st ed.,McGraw Hill Education, 2017
3. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach with C*, 2nd ed., Cengage Learning, 2007

Web and Video link(s):

https://nptel.ac.in/courses/106106130; *NPTEL Video Lecture on Programming and Data Structures Dr. N. S. Narayana Swamy, CSE, IIT Madras.*

Laboratory Manual (for laboratory component):

1. *Data Structures through C Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities

CO2: analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities

CO3: analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities

CO4: develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies

(based on psychomotor skills acquired from laboratory component)

CO5: develop and test basic data structures and array operations, including dynamic memory allocation to evaluate their performance and complexity

CO6: apply the linear data structures such as stacks and queues and perform various operations using LIFO or FIFO order respectively

CO7: solve problems using various linked list representations for efficiently storing and retrieving the data

CO8: apply different sorting techniques on unsorted data and sort them in an order, able to store the data using hashing techniques to retrieve the data very effectively

Course Articulation Matrix (CAM):		**U24AI204 : DATA STRUCTURES THROUGH C**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI204.1**	2	2	2	1	-	-	1	1	1	1	1	2	1
CO2	**U24AI204.2**	2	2	2	2	-	-	1	1	1	1	2	2	2
CO3	**U24AI204.3**	2	2	2	2	-	-	1	1	1	1	2	2	2
CO4	**U24AI204.4**	2	2	2	2	-	-	1	1	1	1	2	2	2
CO5	**U24AI204.5**	2	2	2	1	-	-	1	1	1	1	1	2	1
CO6	**U24AI204.6**	2	2	2	2	-	-	1	1	1	1	2	2	2
CO7	**U24AI204.7**	2	2	2	2	-	-	1	1	1	1	2	2	2
CO8	**U24AI204.8**	2	2	2	2	-	-	1	1	1	1	2	2	2
U24AI204		**2**	**2**	**2**	**1.75**	**-**	**-**	**1**	**1**	**1**	**1**	**1.75**	**2**	**1.75**

BASIC ELECTRICAL ENGINEERING

Class: B.Tech. II -Semester		**Branch:** Common to CSM, CSD,CSN.CSO & IT	
Course Code:	U24EE205B	**Credits**	4
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE**	**60 %**
Total Number of Teaching Hours:	**60 Hrs**	**ESE**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: network elements and DC circuits

LO2: DC network theorems

LO3: 1- Ø AC and 3-Ø AC circuits

LO4: construction, principles and applications of DC & AC machines and concept of Lighting sources

THEORY COMPONENT

UNIT-I	9 Hrs

DC circuits: Network elements, Linear & non-linear elements, Active & passive elements, Unilateral & bilateral elements, Ohm's law, Power, Energy, Kirchhoff's laws, Resistances connected in series and parallel, Voltage divider rule & Current divider rule.

DC Circuit analysis: Source transformation, Star-Delta conversion, Mesh analysis & Nodal analysis (T & π networks only).

Self-Learning Topics (SLTs)*: Definitions of charge, current, & voltage (Text1: Topics1.2,), Solved problems (Text1: Prob 3.10, 3.11 & 3.12), Practice problems (Text1: Chap-3,Prob 4,5,7&8).*

UNIT-II	9 Hrs

DC network theorems (Independent sources only): Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (T & π networks only).

Self-Learning Topics (SLTs): *Condition for maximum power transfer (Text1: Topics3.9), Solved problems (Text1: Prob 3.15, 3.18, 3.23 & 3.25), Practice problems (Text1: Chap-3,Prob 9,10,13 & 14).*

UNIT-III	9 Hrs

1-Ø **AC circuits:** R.M.S value, Average value, Peak factor and form factor of a sine wave, Concept of phasor, Phase and phase difference, Rectangular and polar form representation, Sinusoidal steady state analysis of R, L, C, Series RL, RC, RLC circuits, Concept of Reactance, Impedance, Complex power, Real Power, Reactive power and Power factor.

3- Ø AC circuits: Generation of 3- Ø voltages, Advantages, Disadvantages, Applications of a three-phase system, Voltage & current relationships of line and phase values for balanced star and delta connections.

Self-Learning Topics (SLTs): *Expression for RMS & Average value (Text1: Topic, 4.4 & 4.5) Solved problems (Text1: Prob 4.10, 4.12, 4.13 & 4.14), Practice problems (Text1: Chap-4,Prob 8,9,12&12).*

UNIT-IV	9 Hrs

Electrical Machines & Electrical Lighting (Qualitative treatment):
Construction, Principle of operation, Characteristics & applications of 1- Ø transformer, 3- Ø induction motor, 1- Ø induction motor and DC motor and Types of DC motor.

Electrical lighting sources and Energy calculations:
Lighting sources-incandescent, Fluorescent, CFL & LED lamps, Elementary calculations for energy consumption.

Self-Learning Topics (SLTs): *EMF equation of a Transformer (Text1: Part-II Topic, 4.4.2) Solved problems (Text1: Part-II Prob 4.5, 4.6 & 4.7), Practice problems (Text1: Part-II Prob 5.2, 5.3 & 5.4), Practice problems (Text1: Part-II Prob 6, 7 & 8)*

LABORATORY COMPONENT

List of Experiments

1. Verification of voltage divider rule and current divider rule
2. Verification of Mesh Analysis
3. Verification of Nodal Analysis
4. Verification of Superposition Theorem
5. Verification of Thevenin's Theorem
6. Verification of Maximum power transfer Theorem
7. Determination of internal parameters of a choke coil
8. Impedance calculations and phasor representation of RL series circuit
9. Impedance calculations and phasor representation of RC series circuit
10. Load test on 1-phase transformer
11. Verification of Kirchoff's laws using PSPICE/MATLAB
12. **Interfacing Sensors with Arduino using TINKER CAD**
    i. LED blinking
    ii. IR Sensor
    iii. Ultrasonic Sensor
    iv. Voltage Sensor
    v. Current Sensor
    vi. Speed Sensor

Text Book(s):

1. K. Uma Rao, *Basic Electrical Engineering* , Pearson Education, 2011.

Reference Book(s):

1. B.L.Thereja, A.K.Thereja, *Electrical Technology Vol. I & II* ,S.Chand& Company Ltd, 2005.
2. Edward Hughes, *Electrical & Electronics Technology* , 10th ed., Pearson Education, 2010.
3. D. P. Kothari and I. J. Nagrath, *Basic Electrical Engineering* , Tata McGraw Hill, 2010.
4. Chakravarthy A, Sudhipanath and Chandan Kumar, *Basic Electrical Engineering* , Tata

McGraw Hill Ltd, 2009.

Web and Video link(s):

1. https://nptel.ac.in/courses/108/105/108105112//; *NPTEL Video Lecture on Fundamentals of Electrical Engineering by Prof. Debapriya Das, Professor of EED, IITK Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Basic Electrical & Electronics Engineering Laboratory Manual and Record Book,* Department of EEE, KITSW.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: determine voltage, current & power in electrical circuits using network reduction techniques, mesh & nodal analysis

CO2: apply suitable network theorems to analyze DC circuits

CO3: determine impedance, voltage, current, and power in 1- Ø AC circuits & determine line and phase quantities in 3- Ø AC circuits

CO4 : select a suitable electrical machine for given applications and determine the energy consumed by a lighting load.

CO5: validate mesh and nodal analysis

CO6: validate network theorems

CO7: determine the impedance of series RL & RC circuits at various operating frequencies

CO8: determine the efficiency of a transformer by conducting a load test

Course Articulation Matrix (CAM): U24EE205B: BASIC ELECTRICAL ENGINEERING

CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 1	PSO 2
CO1	**U24EE205B.1**	2	1	-	-	-	-	1	1	1	1	**1**	1	1	1
CO2	**U24EE205B.2**	2	2	-	-	-	-	1	1	1	1	**1**	1	1	1
CO3	**U24EE205B.3**	3	3	1	1	1	1	1	1	1	1	**1**	1	1	1
CO4	**U24EE205B.4**	3	3	1	1	1	1	1	1	1	1	**1**	1	1	1
CO5	**U24EE205B.5**	2	1	-	-	-	-	1	1	1	1	**1**	1	1	1
CO6	**U24EE205B.6**	2	2	-	-	-	-	1	1	1	1	**1**	1	1	1
CO7	**U24EE205B.7**	3	3	1	1	1	1	1	1	1	1	**1**	1	1	1
CO8	**U24EE205B.8**	3	3	1	1	1	1	1	1	1	1	**1**	1	1	1
U24EE205B		**2.5**	**2.25**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	1

3 – HIGH, 2 – MEDIUM, 1 - LOW

ENVIRONMENTAL STUDIES

Class:B.Tech.II Semester		**Branch:**Common to ME, CSM, CSD, IT, CSN & CSO	
CourseCode:	**U24CY206**	**Credits:**	**0**
Hours/Week(L-T-P-O-E):	**2-0-0-5-7**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24Hrs**	**ESE:**	**40%**

CourseLearningObjectives(LOs):

This course will develop students' knowledge in/on…

LO1: natural resources and their usage more equitably

LO2: ecosystem and the importance of biodiversity conservation

LO3: environmental pollution and it'scontrol measures

LO4: environmental legislation and green methodology

UNIT-I	6Hrs

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and importance

Natural Resources: Forest Resources-Use and overexploitation of forests, Deforestation, Timber extraction, Mining, Dams and their effects on forests and tribal people**;** Water Resources-Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water**;** Mineral Resources-Environmental effects of extracting and using mineral resources**;** Energy Resources-Renewable and non-renewable energy sources, Use of alternate energy sources

Self Learning Topics (SLTs): *Use and over-utilization of surface and ground water(Text1: unit 2, topic: 2.2.2) world food problems(Text1: unit 2, topic 2.2.2)*

UNIT-II	6Hrs

Ecosystem and Biodiversity:

Ecosystem: Concepts of an ecosystem, Food chain, Food webs, Ecological pyramids, Energy flow in the ecosystem and ecological succession

Biodiversity and its Conservation: Introduction, Definition, Genetic, Species and ecosystem diversity, Value of biodiversity, Biodiversity in India, Hot spots of biodiversity, Man-wildlife conflicts, Endangered and endemic species of India; In-situ and Ex-situ conservation

Self Learning Topics (SLTs): *Introduction and definition of biodiversity (Text1: unit 4, topic 4.1)*

UNIT-III	6Hrs

Environmental Pollution: Global issues**-**Global climatic change, Greenhouse gases, Effects of global warming, Ozone layer depletion

International Conventions/Protocols: Earth summit, Kyoto protocol, Montreal protocol**Environmental Pollution-**Causes and effects of air, Water, Soil, Marine and noise pollution with case studies

Solid and Hazardous Waste Management: Introduction, Types, Effects of urban industrial and nuclear waste

Natural Disaster Management: Introduction to disaster, Management of disaster, Disaster management of flood, earthquake, cyclone and landslides

Role of information technology in environment and human health

Self Learning Topics (SLTs): *Role of individual in prevention of pollution (Text1: unit 5, topic 5.10)*

UNIT-IV	6Hrs

Social Issues and the Environment: Role of Individual and Society, Water conservation, harvesting

Environmental Protection/Control Acts: Air (prevention and control of pollution) act conservation act (1980 and 1992), Wildlife protection act 1972, Environment protection act involved in enforcement of environmental legislations

Green Methodology: Principles of green chemistry, Green methods in electronic productic electronic waste on public health and environment;United nations goals of sustainable deve

SelfLearningTopics(SLTs):*Water (prevention and control of pollution) act 1974(Text1: unit 6, Water pollution cess act 1977(Text1: unit 6, topics 6.11)*

Course Learning Outcomes(COs):

Aftercompletion of this course,the students should be able to,

CO1: identify the natural resources and practice their usage more equitably

CO2: develop an action plan for sustainable alternatives and conserving biodiversity

CO3: examine and perceive the solutions for the environmental pollution

CO4: adapt issues involved in enforcement of environmental legislationand green methodology

Textbook(s):

1. Erach Bharucha,*TextBook of Environmental Studies for Under Graduate Courses,* ***2nd ed., Universities Press(India)Pvt. Ltd, 2013***

Reference Book(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, B.S. Publications, 2004.
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd ed., Pre India,1991
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 4th ed., New Age Publishers,2014
4. R.Rajagopalan, *Environmental Studies from crisis to cure*, 2nd ed. Oxford University Pres

Web and Video link(s):

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ch27/*video lecture on re energy resources by Prof. Vaibhav. V. Goud and Dr. R. Anandalakshmi, Dept. Of Chemical Guwahati.*

CourseArticulationMatrix(CAM):					U24CY206 : ENVIRONMENTAL STUDIES									
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24CY206.1	2	1	2	1	-	2	1	1	1	1	1	1	1
CO2	U24CY206.2	-	-	2	-	-	2	1	1	1	1	1	1	1
CO3	U24CY206.3	1	2	1	-	-	1	1	1	1	1	1	1	1
CO4	U24CY206.4	-	-	1	-	-	2	1	1	1	1	1	1	1
U24CY206		**1.50**	**1.50**	**1.50**	**1**	**-**	**1.75**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
3–HIGH,2–MEDIUM,1-LOW														

IDEA Lab Makerspace

Class: B.Tech. II -Semester		**Branch:** Common to all branches	
Course Code:	**U24AE207**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: carpentry and CNC wood router

LO2: mould for sand casting and arc welding joints

LO3: laser engraving, 3D printing and robots in manufacturing

LO4: Printed Circuit Board (PCB) and Internet of Things (IoT)

LABORATORY COMPONENT

S. No.	Creative Fabrication Technology	List of Experiments
1.	Carpentry	Prepare a half lap dovetail joint
2.	CNC Wood Router	Perform wood carving using CNC Wood Router
3.	Foundry	Prepare a sand mould using single piece pattern
4.	Welding	Prepare a single V-butt joint on mild steel plates using AC arc welding machine
5.	Injection Moulding	Prepare a plastic product using Injection moulding machine
6.	Laser Engraving	Perform key chain by using CO_2 laser cutting machine
7.	3D Printing	Prepare a key chain on 3D printer with the given dimensions
8.		Prepare a Spur Gear on 3D printer with the given dimensions
9.	Robotics	Perform basic pick-and-place operation using robot
10.	Printed Circuit Board (PCB)	Design and fabricate a PCB for a given application
11.	Internet of Things (IoT)	Measure the temperature and humidity by using DHT11 sensor and Arduino UNO
12.		Create a smart plant watering system using IoT
Course Project		• Students are required to create an affordable prototype as their course project, based on the knowledge and skills acquired during the course. • Students have to present and submit their prototypes to

	demonstrate their ability to apply classroom learning practically, showcasing their creativity and technical aptitude.

<u>Laboratory Manual</u>:

- ***IDEA Lab Makerspace*** *Laboratory Manual & Record Book (LMRB) prepared by the faculty of department of Mechanical Engineering, KITSW, Revised version 4, August-2024.*

<u>Text/ Reference Book(s):</u>

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy., "*Elements of Workshop Technology*", Media Promoters and publishers Pvt. Ltd, India, Vol-I-2008 &Vol-II-2010.
2. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "*Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*", 2nd ed., Springer Nature, 2021.
3. R.S. Khandpur, "*Printed Circuit Boards: Design, Fabrication, Assembly and Testing*", New Delhi Tata Mc Graw Hill-2008.
4. Sudeep Mishra, Anandarupmukherjee and Arijit Roy, "*Introduction to IoT*", New Delhi: University Cambridge Press, 2021.

Course Learning Outcomes (COs):

<u>After completion of this course, the students should be able to</u> …
<u>(based on psychomotor skills acquired from laboratory component)</u>

CO1: produce wooden joints and intricate articles using carpentry and CNC wood router respectively

CO2: implement procedures to prepare the mould cavity for sand casting and arc welding joints

CO3: produce innovative prototypes using laser engraving and 3D printing

CO4: design and develop systems based on PCB and IoT for given applications

Course Articulation Matrix (CAM):		**U24AE207 : IDEA Lab Makerspace**												
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	**U24AE207.1**	2	2	1	1	2	1	1	2	2	1	1	1	1
CO2	**U24AE207.2**	2	2	1	1	2	1	1	2	2	1	1	1	1
CO3	**U24AE207.3**	2	2	1	1	2	1	1	2	2	1	1	1	1
CO4	**U24AE207.4**	2	2	1	1	2	1	1	2	2	1	1	1	1
U24AE207		**2**	**2**	**1**	**1**	**2**	**1**	**-**	**2**	**2**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Programming Skill Development Lab-1

Class: B.Tech. II -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24SE208**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: a solid foundation in C programming, focusing on fundamental concepts such as variables, data types, control structures, loops, and functions to solve computational problems

LO2: apply logical and analytical thinking to devise solutions for moderate to complex problems by writing efficient and optimized C programs

LO3: identify, analyze, and fix errors in C programs by mastering debugging techniques and utilizing testing strategies to ensure code reliability and performance

LO4: developing real-world applications by designing, coding, and implementing projects that simulate industry-standard challenges, thereby preparing for placements and professional careers

LABORATORY COMPONENT

S. No.	List of Experiments
1.	Programs using input output functions, operators
2.	Programs using conditional control structures: if, if-else, nested if
3.	Programs using else if ladder, switch and goto statements
4.	Programs using iterative statements
5.	Programs using iterative statements
6.	Programs on one dimensional array and two-dimensional arrays
7.	Programs on one dimensional array and two-dimensional arrays
8.	Programs on String operations and string handling functions
9.	Programs on different types of functions, parameter passing using call-by-value & call-by-address, recursion and storage classes
10.	Programs on different types of functions, parameter passing using call-by-value & call-by-address, recursion and storage classes
11.	Programs using structures, unions, pointers to arrays and pointers to strings
12.	Programs using array of pointers and pointers to structures

Text/ Reference Book(s):

1. Balagurusamy.E, *Programming in ANSI C*, 8th ed., McGraw Hill, 2022
2. Paul Deitel, Harvey Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, 9th ed., Pearson Education Limited, 2022
3. Brian W. Kernighan and Dennis Ritchie, *The C Programming Language*, 2nd ed., Pearson Education India, 2015
4. Reema Thareja, *Programming in C,* Oxford University Press, 3rd ed., 2023
5. Yashavant Kanetkar, *Let Us C,* 19th ed., BPB Publications, 2022
6. A.K.Sharma, *Computer Fundamentals and Programming in C,* 2nd ed., Universities Press, 2018

Course Learning Outcomes (COs):

After completion of this course, the students should be able to …
(based on psychomotor skills acquired from laboratory component)

CO1: develop efficient and optimized C programs to solve a range of moderate to complex problems, demonstrating a strong understanding of programming fundamentals and algorithm design

CO2: analyze and debug C programs to identify errors and optimize code performance, employing appropriate debugging techniques and tools

CO3: apply advanced programming concepts such as dynamic memory allocation, data structures, and file handling in C to create robust and scalable solutions

CO4: design, implement, and test real-world applications in C, simulating industry scenarios and preparing for technical roles in software development and problem-solving

Course Articulation Matrix (CAM):					**Programming Skill Development Lab-1**									
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24SE208.1**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO2	**U24SE208.2**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO3	**U24SE208.3**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO4	**U24SE208.4**	2	2	1	1	1	-	1	1	1	1	1	2	2
U24SE208		**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

PRACTICUM - II

Class: B.Tech. II -Semester	**Branch:** Common to all branches		
Course Code:	**U24EL209**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps
LO2: implementing a project independently by applying knowledge to practice
LO3: preparingwell-documented report and informative PPT
LO4: effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:**In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH201	U24PY202B	U24AI203	U24AI204	U24EE205B	U24CY206
Students allotted to different	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053

courses	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : ……….

S.No.	Roll number of the student	Practicum topic Allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under

supervision of allotted course faculty, in the allotted hours in the classwork timetableand alsooutside the class work hours during weekdays.

3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

(Signature of class teacher)

****

(i). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(ii). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(iii). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(iv). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(v). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(vi). A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggestfor addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicumreport should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacheras per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination

in the following cases: i) he/she is absent for oral presentation and viva-voce ii) he/she fails to submit the report in prescribed format iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines
Course Learning Outcomes (COs): *After completion of this course, the students should be able to…* **CO1**: synthesize literature survey, identify research gaps anddefine objective & scope of practicum problem **CO2**: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system **CO3**: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum **CO4**: create a video pitch on practicum and make an effective oral presentation using PPTs

Course Articulation Matrix (CAM):		**U24EL209 PRACTICUM-2**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL209.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL209.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL209.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL209.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL209		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

SOCIAL EMPOWERMENT ACTIVITY-2 / SELF ACCOMPLISHMENT ACTIVITY-2 (SEA-2 /SAA-2)

Class: B.Tech. II Semester	**Branch:** Common to all branches		
Course Code:	**U24VAXYY(SE/SA)ZZZ**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experiencewhicheffectively help individualsdeal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentationthrough PPTs portraying knowledge, skills,qualitiesacquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) isintroduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual andsocial aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses,which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (SelfAccomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student

develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester,through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(a) **Nodal units:**The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i^{2}RE)shall act as nodal units for activities listed under SEA/SAA.

(b) During the semester period, the student has to**acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition& Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. **As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interacteminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders.Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:**The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentationand report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every studentshall, identifiesminimum of4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:***There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counsellor
Total	**100**	**-**

Note:

(f) **Presentation/ Demonstration:**It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(g) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(h) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(i) **Requirements for passing the course:** A student is deemed to have passed

SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
b. scores a minimum of 40 marks in the CIE of the course

(j) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in makinga well-documented report and an effective oral presentationwith PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Text / Reference Book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Articulation Matrix (CAM):		**U24VAXYY(SE/SA)ZZZ - Courses listed under SEA/ SAA**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**U24VAXYY.1**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO2	**U24VAXYY.2**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO3	**U24VAXYY.3**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO4	**U24VAXYY.4**	-	-	-	-	-	2	2	2	2	2	2	1	1
U24VAXYY		-	-	-	-	-	2	2	2	2	2	2	1	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Course Code: **U24VA XYY(SE/SA)ZZZ**

X represents semester; YYrepresents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

EXPERT TALK SERIES – 2

Class: B.Tech. II -Semester	**Branch:** Common to all branches		
Course Code:	**U24AE211**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice andapplying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented reportportraying the knowledge, skills, qualities acquired and the impact of the learning

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples,is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations”.

But how would you know all this without venturing into the industry?

(a) The answer is Industry**Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(b) Through Industry expert talks students get to know so much more that textbooks don’t explain.

(c) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(d) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(e) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(f) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(g) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(h) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(i) ETS enhances your learning in many ways for global opportunities for your career.

(j) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(k) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i^{2}RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode**by the parent department / Centre for i^{2}RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs;*duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i^{2}RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:**At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:**There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(l) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

ii. **Supplementary Exam:**

(i) Student has to register for ETS supplementary examination if he/she scores less than 40 marksin CIE

(ii) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks(MCQs/FiBs ; *duration: 2Hrs*)on the content covered in ETS lectures.

(iii) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(iv) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

Course Articulation Matrix (CAM):		**U24AE211 : EXPERT TALK SERIES-2**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AE211**.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	**U24AE211**.2	1	1	1	1	1	1	2	1	2	1	2	1	1
CO3	**U24AE211**.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	**U24AE211**.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE211		**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Semester -II Exit Option Syllabi

Bridge Courses for exit:

Successful completion of twosubjects (6-Credits)during 2-months internship at the institute
OR
Successful completion of twosuitable skill based courses (external) to qualify for Certification

A. After First Year: (UG Certificate in CSE(AI & ML))
(i) The candidate should pass any two of the following additional courses (ITI Level) during the 2-Months internship at institute

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

Exit Option to Qualify UG Certificate in CSE(AI & ML): Any Two (02) Courses during the 2 - Months internship

S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	PCC	U24AI212X	Introduction to Python Programming	2	-	2	-	4	3
2	PCC	U24AI213X	Programming with Java	2	-	2	-	4	3
3	PCC	U24AI214X	Introduction to Databases	2	-	2	-	4	3
4	PCC	U24AI215X	Fundamentals of Computer Networks	2	-	2	-	4	3
5	PCC	U24AI216X	Any other course approved by BoS Chair and Dean AA	2	-	2	-	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for Certification.

Exit Option to Qualify UG Certificate in CSE(AI & ML): Any Two (02) Skill based Courses -:

S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
1	SEC	U24SE217X	**Core Python Programming** **Reference:** https://www.netacad.com/courses/programming/pcap-programming-essentials-python	-	-	6	-	6	3
2	SEC	U24SE218X	**Java Fundamentals**	-	-	6	-	6	3

Exit Option to Qualify UG Certificate in CSE(AI & ML): Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
			Reference: https://learn.oracle.com/ols/learning-path/java-fundamentals/55593/55578						
3	SEC	U24SE219X	**Database Foundations** **Reference:** https://academy.oracle.com/en/solutions-curriculum-database.html	-	-	6	-	6	3
4	SEC	U24SE220X	**Introduction to Unix Operating System** **Reference:** https://www.coursera.org/learn/hands-on-introduction-to-linux-commands-and-shell-scripting	-	-	6	-	6	3
5	SEC	U24SE221X	**Networking Fundamentals** **Reference:** https://www.netacad.com/courses/networking/ccna-introduction-networks	-	-	6	-	6	3
6	SEC	U24SE222X	Any other skill based course approved by BoS Chair and Dean AA	-	-	6	-	6	3

INTRODUCTION TO PYTHON PROGRAMMING

Class: B.Tech. II – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI212X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: python syntax, operators, and control statements
LO2: creating functions, utilizing modules, and understanding namespaces in Python
LO3: manipulate strings and understanding data structures such as lists, tuples, and dictionaries
LO4: file operations and learning to implement exception handling in Python

THEORY COMPONENT

UNIT-I	**4 Hrs**

Python Programming: Features of Python, The future of Python, Writing and executing Python programs

Python Preliminaries: Literal constants, Variables and identifiers, Data types, Input operation, Comments, Reserved words, Indentation, Operators, Expressions in Python, Type conversion

Decision Control Statements: Selection/Conditional branching statements, Loop structures/iterative statements, Nested loop, the break statement, the continue statement, the pass statement, the else statement used with loops

UNIT-II	**4 Hrs**

Functions: Function definition, Function call, Variable scope and lifetime, the return statement, Advances in defining in functions, Lambda functions, Recursive functions

Modules and Name Spaces: The from … import statement, Naming module, Making your own modules, the dir() function, Standard library modules, globals(), locals(), and reload(), Function redefinition

UNIT-III	**4 Hrs**

Python Strings: String operations, String formatting operator, Built-in string methods and functions, slice operation, ord() and chr() Functions, in and not in operators, Comparing strings, Regular expressions and meta characters

Data Structures: Lists, Tuple, Dictionaries

UNIT-IV	4 Hrs

Files: Opening and closing files, Reading and writing files, File positions, Renaming and deleting files

Error and Exception Handling: Handling Exceptions, Multiple Except Blocks, Multiple exceptions in a single block, Except block without exception, The else clause, Raising exceptions, Handling exceptions in invoked functions, Built-in exceptions, The finally block

LABORATORY COMPONENT

List of Experiments

Unit-1:

1. Develop a Python program that uses decision control statements to determine if a given number is positive, negative, or zero.
2. Develop a python program to implement and compare different loop structures (for loop, while loop) to solve a problem, such as generating a sequence of numbers or performing a series of calculations.
3. Develop a Python program to validate user input and provide appropriate feedback based on various conditional checks, such as checking if an input string meets certain criteria (e.g., length, content).
4. Develop a Python program that utilizes the break, continue, and pass statements within loops to control the flow of execution based on specific conditions.

Unit-2:

5. Develop a Python function that performs a specific task, such as calculating the factorial of a number, and demonstrates how to call this function from different parts of a program.
6. Develop a Python program that defines and uses a lambda function to perform a simple operation, such as filtering or mapping a list of values.
7. Develop a Python program that demonstrates the use of modules and imports by creating a custom module with multiple functions and importing it into a main script.
8. Develop a Python program that illustrates variable scope and lifetime by defining functions with local and global variables and observing how these variables are accessed and modified.

Unit-3:

9. Develop a Python program to perform basic string operations, including slicing, concatenation, and formatting, and demonstrate their use in processing and displaying text data.
10. Develop a Python program that uses lists, tuples, and dictionaries to store and manipulate data. For example, develop a simple contact management system that adds, updates, and retrieves contact information.
11. Develop a Python script to perform various operations on strings, such as counting occurrences of specific characters, reversing a string, and finding substrings.

Unit-4:

12. Develop a Python script that reads data from a file, processes the data (e.g., counting lines or words), and writes the results to a new file. Include error handling for file access errors.
13. Develop a Python program that demonstrates exception handling by intentionally causing errors (e.g., dividing by zero, accessing an invalid dictionary key) and using try-except blocks to manage these exceptions.

Text Book(s):

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed., New Delhi: Oxford University Press, 2017. (Chapters 3 to 8, 12)

Reference Book(s):

1. William Punch and Richard Enbody, *Practice of Computing Using Python,* 3rd ed., Noida: Pearson, 2015
2. Dr.Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, 1st ed., Mumbai: Shroff Publishers, 2017,
3. David Beazley, *Python Cookbook,* 3rd ed., Sabastopol, CA: O'Reilly Media, 2013

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs32/preview; *NPTEL Video Lecture on Python Programming by Prof. Sudarshan Iyengar, Professor of E&ECE, IIT Ropar.*

Laboratory Manual (for laboratory component):

1. *Python Programming Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on cognitive skills acquired from theory component)

CO1 : develop python programs using python syntax, operators and control statements

CO2 : develop and utilize functions, import and manage modules, and understand the use of namespaces to organize code efficiently

CO3 : manipulate strings and utilize data structures such as lists, tuples, and dictionaries to solve complex problems

CO4 : develop programs using file read/write operations and implement robust exception handling mechanisms to manage errors and ensure program reliability

(based on psychomotor skills acquired from laboratory component)

CO5 : develop and execute Python programs that utilize fundamental syntax, operators, and control statements

CO6 : develop python functions, organize code using modules, and manage namespaces to create modular and reusable Python programs

CO7 : apply techniques to manipulate strings and utilize data structures such as lists, tuples, and dictionaries to solve real-world problems

CO8 : develop python programs involved in file read/write operations and implement exception handling to manage errors and ensure the robustness of Python programs

Course Articulation Matrix (CAM):		U24AI212X : INTRODUCTION TO PYTHON PROGRAMMING												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI212X.1**	1	2	2	1	-	-	1	1	1	-	1	2	2
CO2	**U24AI212X.2**	2	2	3	2	-	-	1	1	1	-	2	2	2
CO3	**U24AI212X.3**	2	2	3	2	-	-	1	1	1	-	2	2	2
CO4	**U24AI212X.4**	2	2	3	3	-	-	1	1	1	-	2	2	2
CO5	**U24AI212X.5**	1	2	2	2	-	-	1	2	1	2	1	2	2
CO6	**U24AI212X.6**	2	2	3	2	-	-	1	2	1	2	2	2	2
CO7	**U24AI212X.7**	2	2	3	2	-	-	1	2	1	2	2	2	2
CO8	**U24AI212X.8**	2	2	3	2	-	-	1	2	1	2	2	2	2
U24AI212X		**1.75**	**2**	**2.75**	**1.75**	**-**	**-**	**1**	**1.5**	**1**	**2**	**1.75**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

PROGRAMMING WITH JAVA

Class: B.Tech. II -Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI213X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: data types, operators, control statements, and arrays
LO2: classes, methods, and strings
LO3: types of inheritance, dynamic method dispatch, and interfaces
LO4: streams (I/O) and exception handling

THEORY COMPONENT

UNIT-I	4 Hrs

Programming Paradigms: Object oriented programming (OOP) concepts

Java Basics: An overview of java, Data types, Variables and arrays, Operators, Control statements

Introducing classes: Class fundamentals, Objects, Methods, Object reference variables

UNIT-II	4 Hrs

Classes and Methods: Overloading methods, this keyword, Passing and returning objects, Recursion, Constructors, Overloading constructors, static variables, static blocks and static methods, Nested and inner classes, Command line arguments

Strings: Exploring String, StringBuffer

UNIT-III	4 Hrs

Inheritance: Inheritance basics, Types of inheritance, super keyword, Method overriding, Order of constructors calling, Dynamic method dispatch, Abstract classes, final with inheritance, Object class

Interfaces: Defining an interface, Implementing interfaces, Nested interfaces

UNIT-IV	4 Hrs

Using I/O: I/O basics, Reading, Writing and copying files

Exception Handling: Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Nested try statements, throw, throws, finally

List of Experiments

Experiment-I

1. Develop a java program to demonstrate different operators supported by java.
2. Develop a java program to demonstrate control structures.
3. Develop a java program to demonstrate switch statement.

Experiment-II

4. Develop a java program to read an array and display them using for-each control.
5. Develop a java program to read a matrix and display whether it is an identity matrix or not. Use civilized form of break statement.
6. Develop a java program to define a two-dimensional (2D) array where each row contains different number of columns. Display the 2D-array using for-each.

Experiment-III

7. Develop a java program to demonstrate class concept.
8. Develop a java program to demonstrate this keyword.
9. Develop a java program to demonstrate overloading of methods.

Experiment-IV

10. Develop a java program to demonstrate constructors.
11. Develop a java program to demonstrate nested and inner classes.
12. Develop a java program to demonstrate static variables, static methods, and static blocks.

Experiment-V

13. Develop a java program to read at least five strings from command line argument and display them in sorted order.

Experiment-VI

14. Develop a java program to accept a string, count number of vowels and remove all vowels.
15. Develop a java program to accept a string, count number of vowels and remove all vowels using StringBuffer class.

Experiment-VII

16. Develop a java program to demonstrate single level-inheritance.
17. Develop a java program to demonstrate multilevel-inheritance using super.
18. Develop a java program to demonstrate method overriding.

Experiment-VIII

19. Develop a java program to demonstrate dynamic method dispatch.
20. Develop a java program to demonstrate use of abstract class.

Experiment-IX

21. Develop a java program to implement interfaces.
22. Develop a java program to extend the interfaces.

Experiment-X

23. Develop a java program to demonstrate implementation of nested interfaces.

Experiment-XI

24. Develop a java program to demonstrate try-catch block.
25. Develop a java program to demonstrate throw clause.

26. Develop a java program to demonstrate throws clause.

Experiment-XII

27. Develop a java program to demonstrate read/write/copy a file.

Text Book(s):

1. Herbert Schildt, *Java The Complete Reference*, 11th ed., New Delhi: McGraw-Hill Education, 2019,

Reference Book(s):

1. Kathy Sierra, Bert Bates, *Head First Java*, 2nd ed., O'Reilly Publications, 2013
2. Uttam K. Roy, *Advanced JAVA Programming*, 1st ed., Oxford Publications, 2013
3. Balaguruswamy, *Programming with Java: A Primer*, 6th ed., New Delhi: McGraw-Hill Education India Pvt. Ltd, 2019
4. Tanweer Alam, *Internet and Java Programming*, 1st ed., New Delhi: Khanna Publishing House, 2010

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs58/preview; *NPTEL Video Lecture on Programming in Java by Prof. Debasis Samanta, Professor of CSE, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Programming in Java laboratory manual and Record Book,* Department of CSE(AI&ML), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply fundamental java concepts, including data types, variables, arrays, operators, and control statements, to develop and debug basic java programs

CO2: design and implement java programs using classes including overloading, recursion, and string manipulation techniques to solve complex problems

CO3: apply inheritance and interface concepts to develop robust java applications

CO4: develop java programs that incorporate file handling and implement effective exception handling strategies to ensure program reliability and error management

CO5: develop and debug java programs demonstrating basic syntax, data types, operators, and control statements, including the use of classes and methods

CO6: design and develop java applications using object-oriented principles and recursion

CO7: apply file operations and exception handling techniques to manage file reading, writing, and error handling in java programs

CO8: utilize string manipulation and advanced class features to solve complex programming problems

Course Articulation Matrix (CAM):		U24AI213X : PROGRAMMING WITH JAVA												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI213X.1**	2	1	1	1	-	-	1	1	1	-	2	2	1
CO2	**U24AI213X.2**	2	2	2	2	-	-	1	1	1	-	2	2	1
CO3	**U24AI213X.3**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO4	**U24AI213X.4**	2	3	2	2	-	-	1	1	1	-	2	2	2
CO5	**U24AI213X.5**	2	1	1	1	-	-	1	2	1	-	2	2	1
CO6	**U24AI213X.6**	2	2	2	2	-	-	1	2	1	-	2	2	1
CO7	**U24AI213X.7**	2	2	2	2	-	-	1	2	1	-	2	2	2
CO8	**U24AI213X.8**	2	3	2	2	-	-	1	2	1	-	2	2	2
U24AI213X		**2**	**2**	**1.75**	**1.75**	**-**	**-**	**1**	**1.5**	**1**	**-**	**2**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

INTRODUCTION TO DATABASES

Class: B.Tech. II – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI214X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: database system concepts, architecture, relational data models and constraints
LO2: Entity-Relationship database model and SQL
LO3: normalization techniques for designing a database
LO4: transaction in a database and concurrency control

THEORY COMPONENT

UNIT-I	**4 Hrs**

Databases and Database Users: Characteristics of database approach, Advantages of using DBMS, When not to use DBMS

Database System Concepts and Architecture: Data models, Schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, The database system environment, Classification of database management systems.

The Relational Data Model and its constraints: Relational model concepts, Relational constraints and the relational database schemas, Update operations and dealing with constraint violations

UNIT-II	**4 Hrs**

Data Modeling using the Entity–Relationship Model: Using high-level conceptual data models for database design, Entity types, Entity sets, Attributes and keys, Relationships types, Relationship sets, Roles and structural constraints, Weak entity types, ER diagrams

Basic SQL: SQL Data definition and data types, Specifying constraints in SQL, Basic retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL

UNIT-III	**4 Hrs**

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms on Primary keys, General definitions of second and third normal form, Boyce-Codd normal form

UNIT-IV	**4 Hrs**

Introduction to Transaction Processing: Introduction to transaction processing, Transaction and system concepts, Desirable properties of a transactions, Characterizing schedules based on recoverability and serializability

Concurrency Control Techniques: Two-Phase locking techniques for concurrency control, Concurrency control based on timestamp ordering

LABORATORY COMPONENT

List of Experiments

1. Design and implement DDL,DML, TCL and DCL.
2. Design and implement Queries on types of constraints.
3. Design and implement Queries using built-in functions of NUMBER, CHARACTER and DATE Data types.
4. Design and implement Queries on Data type conversion functions.
5. Design and implement Queries on single row functions and operators.
6. Design and implement Queries on aggregate functions.
7. Design and implement Queries on joins and nested queries.
8. Construct SQL statements to create simple, composite indexes, user-defined data types, views, sequences.
9. Implementation of sample PL/SQL programs using conditional and iterative statements.
10. Implementation of PL/SQL programs using cursors.
11. Implementation of PL/SQL programs using parameterized cursors.
12. Create PL/SQL programs to handle exceptions.

Textbook(s):

1. Ramez Elmasri, Shamakanth B. Navathe, *Fundamentals of Database Systems*, 7th ed., New Delhi, 2017

Reference Book(s):

1. Raghu RamaKrishnan, Johannes Gehrke, *Database Management Systems*, 4th ed., New Delhi: Mc-Graw Hill, 2014,
2. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, *Database System Concepts*, 6th ed., New Delhi: McGraw-Hill, 2011

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs75/preview, *NPTEL Video Lecture on Database Management Systems by Prof. Partha Prathim Das, Professor of CSE, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Database Management Systems Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW.

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze and evaluate the characteristics, architecture, and relational constraints of database management systems to design robust database solutions

CO2 : design and optimize complex database schemas using the Entity-Relationship

	model and implement robust data definitions, constraints, and manipulations using SQL
CO3 :	analyze and apply normalization principles and functional dependencies to design efficient and well-structured relational database schemas
CO4 :	evaluate and implement advanced transaction processing techniques and concurrency control methods to ensure data integrity and optimal database performance
(based on psychomotor skills acquired from laboratory component)	
CO5 :	develop and test advanced SQL queries using built-in functions, data type conversion functions, and aggregate functions to manipulate and analyze data effectively
CO6 :	design and test complex SQL queries for creating and managing constraints, indexes, user-defined data types, views, and sequences to enhance database performance and maintainability
CO7 :	develop and execute PL/SQL programs incorporating conditional and iterative statements, cursors, and parameterized cursors to create dynamic and efficient database applications
CO8 :	develop and test robust PL/SQL programs to handle exceptions, ensuring reliable and error-free database operations

Course Articulation Matrix (CAM):		**U24AI214X : INTRODUCTION TO DATABASES**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI214X.1**	1	2	2	1	1	-	1	1	1	-	1	2	2
CO2	**U24AI214X.2**	2	2	3	2	2	-	1	1	1	-	2	2	2
CO3	**U24AI214X.3**	2	2	3	2	2	-	1	1	1	-	2	2	2
CO4	**U24AI214X.4**	2	2	3	3	2	-	1	1	1	-	2	2	2
CO5	**U24AI214X.5**	1	2	2	2	1	-	1	2	1	2	2	2	2
CO6	**U24AI214X.6**	2	2	3	2	2	-	1	2	1	2	2	2	2
CO7	**U24AI214X.7**	2	2	3	2	2	-	1	2	1	2	2	2	2
CO8	**U24AI214X.8**	2	2	3	2	2	-	1	2	1	2	2	2	2
U24AI214X		**1.75**	**2**	**2.75**	**2**	**1.75**	**-**	**1**	**1.5**	**1**	**2**	**1.875**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

FUNDAMENTALS OF COMPUTER NETWORKS

Class: B.Tech. II –Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI215X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE :**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE :**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: computer networks reference models, physical layer components & network switching
LO2: data link and medium access control protocols
LO3: routing algorithms & internetworking
LO4: transport and application layer protocols used in the networks

THEORY COMPONENT

UNIT-I	4 Hrs

Fundamentals of Computer Networks: Uses of computer networks, Network hardware, Network software Reference Models: OSI reference model, TCP /IP reference model, Comparison of OSI and TCP/IP reference model

Physical Layer: Transmission media - Guided transmission media, Wireless transmission; Digital modulation and multiplexing Switching: Circuit and Packet switching

UNIT-II	4 Hrs

Data Link Layer: Data link layer design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols

Medium Access Control Sub Layer: IEEE standard 802.3, Token bus, Token ring, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, Data link layer switching

UNIT-III	4 Hrs

Network Layer: Network layer design issues, Routing algorithms - Optimality principle, Shortest path algorithm, Flooding, broadcast routing, Multicast routing

Internetworking: How networks differ, how networks can be connected, Tunneling, Internetwork routing, Packet fragmentation

UNIT-IV	4 Hrs

Network Layer In The Internet: IP version 4 protocols, IP addresses, IP version 6 protocol, Internet control protocols, Internet multicasting

Transport Layer: Transport services, Elements of transport protocols – Connection establishment and release, Error control and flow control, Crash recovery, Multiplexing congestion control

Internet transport protocols - UDP, TCP

Application Layer: Domain name system (DNS), Electronic mail, World Wide Web

LABORATORY COMPONENT

List of Experiments

1. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool, Study of Network Devices.
2. Setting up LAN, checking for connectivity, basic network commands and Network configuration, Interpreting *Ping* and *Traceroute* Output.
3. Configure of TCP/IP protocols in Window/LINUX with Subnet masking.
4. Examine Network Address Translation (NAT)
5. Configure Static and Dynamic Routing with Static and Default Routes.
6. Configure Ethernet and Serial Interfaces.
7. Configure RIP.
8. Configure Network Firewalls for securing the network.
9. Configure a Cisco Router as a DHCP Server.
10. Capture Packets Using Wireshark tool.
11. Analysing the packet traffic for Statistics with Filters.

Text Book(s):

1. Andrew S. Tannenbaum, David J. Wetherall, *Computer Networks*, 5th ed., London: Pearson Education, 2011

Reference Book(s):

1. William Stallings, *Data and Computer Communications*, 10th ed., London: Pearson Education, 2014
2. Behrouz Forouzan, *Data Communication and Networking*, 5th ed., New York: Tata McGraw Hill, 2012
3. Larry Peterson, Bruce S Davie, *Computer Networks*, 5th ed., New York Elsevier Inc., 2011,
4. James F. Kurose and Keith W. Ross, *Computer Networking A Top-Down Approach*, 6th ed., London: Pearson Education, 2013,

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs69/preview; *NPTEL Video Lecture on Demystifying Networking, by Prof. Sridhar Iyer, Prof. Ashutosh Raina, IIT Bombay*

Laboratory Manual (for laboratory component):

1. *Computer Networks laboratory manual and Record Book,* Department of CSE (AI & ML), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on cognitive skills acquired from theory component)

CO1: evaluate and compare network hardware, software, reference models, and transmission techniques to design optimized network solutions

CO2: analyze and design robust data link layer protocols and medium access control techniques to ensure efficient and reliable network communication

CO3:	analyze and implement advanced routing algorithms and internetworking techniques to design efficient and scalable network infrastructures
CO4:	evaluate and implement IP protocols, transport protocols, and application layer services to design and optimize comprehensive network communication systems
(based on psychomotor skills acquired from laboratory component)	
CO5:	develop and configure TCP/IP protocols and sub-netting on Windows/Linux systems to ensure efficient network communication and address management
CO6:	analyze and implement network security measures by configuring firewalls and examining Network Address Translation (NAT) to protect and manage network traffic
CO7:	design and implement dynamic and static routing protocols, including RIP, to optimize network routing and ensure reliable data transmission
CO8:	utilize network analysis tools such as Wireshark to capture and analyze packet traffic, applying filters to interpret network performance and troubleshoot issues

Course Articulation Matrix (CAM):		**U24AI215X FUNDAMENTALS OF COMPUTER NETWORKS**											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI215X.1**	1	2	2	2	-	-	1	1	1	-	1	2	2
CO2	**U24AI215X.2**	2	2	2	2	-	-	1	1	1	-	1	2	2
CO3	**U24AI215X.3**	2	2	2	2	-	-	1	1	1	-	1	2	2
CO4	**U24AI215X.4**	2	2	2	2	-	-	1	1	1	-	1	2	2
CO5	**U24AI215X.5**	2	2	2	2	2	-	1	2	1	2	1	2	2
CO6	**U24AI215X.6**	2	2	2	2	2	-	1	2	1	2	1	2	2
CO7	**U24AI215X.7**	2	2	2	2	2	-	1	2	1	2	1	2	2
CO8	**U24AI215X.8**	2	2	2	2	2	-	1	2	1	2	1	2	2
U24AI215X		**1.875**	**2**	**2**	**2**	**2**	**-**	**1**	**1.5**	**1**	**2**	**1**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Semester -III Syllabi

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

III SEMESTER

S. No.	Category	Course Code	Course Title	Lectures / week					Credits
				L	T	P	O	E	C
1	BSC*	U24MH301E*	Essential Mathematics and Statistics for Machine Learning*	2	1	-	6	9	3
2	PCC	U24AI302	Advanced Data Structures	2	1	2	5	10	4
3	PCC	U24AI303	Operating Systems	2	1	-	5	8	3
4	PCC	U24AI304	Automata Theory and Compiler Design	2	1	-	4	7	3
5	PCC	U24AI305	Object Oriented Programming through Java	2	1	2	5	10	4
6	VAC*	U24VA306B*	Soft & Interpersonal Skills*	2	-	-	2	4	1
7	SEC	U24SE307	Programming Skill Development (PSD) Lab - 2	-	-	2	2	4	1
8	ELC	U24EL308	Practicum-3	-	-	-	4	4	1
9	VAC	U24VA309XX XXX	SEA-3 / SAA -3	-	-	-	2	2	1
10	AEC	U24AE310	Expert Talk Series-3	-	-	-	1	1	1
			Total:	12	5	6	36	59	22
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				"Programming in C" bridge course for Non-CS/IT Lateral Entry students					

** Branch Specific Mathematics:*

Branch Specific Mathematics (Pool-4)		
S. No.	*Course Code*	*Course Title*
1.	*U24MH301A*	*Numerical and Statistical Methods (for Civil Engineering)*
2.	*U24MH301B*	*Applied Mathematics (for Mechanical Engineering)*
3.	*U24MH301C*	*Applied Mathematics (Common to ECI, EEE & ECE)*
4.	*U24MH301D*	*Discrete Mathematics and Probability Statistics (Common to CSE, CSN, CSO & IT)*
5.	*U24MH301E*	*Essential Mathematics and Statistics for Machine learning (for CSM)*
6.	*U24MH301F*	Essential Mathematics and Statistics for Data science *(for CSD)*

** VAC (Value Added Course):*

T&P Basket		
S. No.	*Course Code*	*Course Title*
1.	*U24VA306A*	*Qunatitative Aptitude and Logical Reasoning*
2.	*U24VA306B*	*Soft & Interpersonal Skills*

ESSENTIAL MATHEMATICS AND STATISTICS FOR MACHINE LEARNING

Class: B.Tech.- III-Semester		**Branch:** CSE (AI&ML)	
CourseCode:	**U24MH301E**	**Credits:**	**3**
Hours/Week(L-T-P-O-E):	**2-1-0-6-9**	**CIE:**	**60 %**
TotalNumberofTeachingHours:	**36 Hrs**	**ESE:**	**40 %**

CourseLearningObjectives(LOs):

This course will develop students 'knowledge in/on…

LO1: vector space, linear dependence, matrix decompositions, multivariate calculus and its applications

LO2: Baye's theorem, random variables and theoretical probability distributions

LO3: correlation, regression, curve fitting and applications of sampling distributions in testing of hypothesis

LO4: dimensionality reduction with principal component analysis (PCA) and optimization techniques

UNIT-I	9 Hrs

Linear algebra: Introduction to vectors, Vector space and subspace, Linear combination and span, Linear independence and dependence, Basis vectors, Linear transformations, Null space and range of linear map and Rank-nullity theorem

Matrix decompositions:LU decomposition, Gram Schmidt process, QR decomposition, Singular

value decomposition and properties, Norms and Matrix approximations

Multivariate calculus: Partial differentiation and gradient, Jacobian matrix, Gradients of matrices,

Hessian matrix, Convex sets, Convex functions and multivariate Taylor series

Self-LearningTopics(SLTs):*Additional problems on linear independence and dependence[Text 3: topic*

6.3; Exercises 8, 9],Additional problems on LU decomposition [Text 3: topic1.8; Exercises 3, 4],Additional

problems on Gram Schmidt Process[Text 3: topic 6.8; Exercises 7, 12, 13],Additional problems on Singular *value decomposition[Text 2: topic4; Exercises 4.8, 4.9], Additional problems on QR decomposition[Text 3: topic 7.1; Exercises 1, 3, 4],AdditionalproblemsonNorms [Text 3:topic 4.2,Exercises:10, 12], Additional problems on convex functions[Text 2:topic 7.3, Example 7.3, 7.4]*

UNIT-II	9 Hrs

Probability: Basic rules and axioms, Dependent and independent events,Conditional probability, Baye's theorem
Random variables: Discrete and continuous random variables, Expectation and variance
Distributions: Binomial, Poisson and Normal distributions
Joint probability distributions: Joint probability mass and density function, Marginal probability mass and density functions and Covariance
Self-Learning Topics (SLTs): *Additional problems on Baye's theorem [Text 1: topic 4.9, Solved problem:*
4.30,4.31 Practice problems: exercise 4(d) (2)], Additional problems on Binomial distribution [Text 1: topic
7.2, Solved problem: 7.4, 7.6, Practice problems: exercise 7(a); 7, 9], Additional problems on Poisson
distribution [Text 1: topic 7.3, Solved problem: 7.27, 7.30, 7.44 Practice problems: Exercise 7(b); 11, 15(c)],
Additionalproblems on Normal distribution [Text 1: topic 8.2, Solved problem: 8.12, 8.13, 8.20(b), Practice problems: exercise8(b); (7)], Additional problems onJoint probability distributionsdistribution
[Text 1: topic 5.5, Solved problem: 5.21, 5.23, 5.26, 5.32, Practice problems: Exercise 5(e); 3, 4, 8(a), 9(b)]

UNIT-III	9 Hrs

Statistics: Measures of Central tendency, Measures of dispersion, Skewness, Kurtosis, Correlation-Coefficient of correlation, Linear Regression,Curve fitting and Method of least squares

Sampling: Types of Sampling, Population, Sample, Parameter, Statistics, Sampling distribution of means (σ-known)and **E**stimation

Testof hypothesis: Procedure for testing hypothesis, Test of significance of a single mean and difference of means-Large samples, Test of significance of a single Mean and difference of means-Small samples, Paired Sample t-test, F-test, F-test for equality of populationvariances, Chi square test, Chi-square test for goodness of fit and One-way ANOVA.

Self-Learning Topics (SLTs): **:***Additional problems on Measures of Central tendency[Text1:topic 2.5, Example 2.1:topic 2.6: Example 2.5, topic 2.7, Example 2.9], Additional problems on Measures ofdispersion[Text 1:topic 3.3, Example 3.1, 3.7, 3.9, Additional problems onSkewness [Text 1:topic 3.13, Additional problems onSkewness and Kurtosis [Text 1:topic 3.13, Exercise 3.9, 3(a), 6(a), Additional problems on coefficient of correlation [Text 1: topic 10.1, Exercise 10(a): 3, 5], Additional problems on lines of regression [Text 1: topic 10.7.1, Exercise 10(d): 8(a),(b),(c)], Additional problems on Fitting of a straight line and second degree parabola [Text 1: topic 9.1.1, 9.1.2: Exercise 1(b), 5(b)],Additional problems on chi square test for goodness of fit[Text 1: topic 13.7.2, Solved problem: 13.14 Practice problems: exercise 13(b) (3.a)], Additional problems on Paired t-test for single mean [Text 1: topic 14.2.9, Solved problem: 14.3 Practice problems: exercise 14(b) (4.b)],Additional problems on t-test for difference of means [Text 1: topic 14.2.10, Solved problem: 14.8 Practiceproblems: exercise 14(c) (2)], Additional problems on F-test[Text 1: topic 14.5.5, Solved problem: 14.20 and 14.22].*

UNIT-IV	9 Hrs

Dimensionality Reduction with Principal Component Analysis: Problem setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low-Rank Approximations, PCA in High Dimensions, Key Steps of PCA in Practice and Latent Variable Perspective.

Optimization: Optimization problem, Unconstrained optimization and constrained optimization.

Unconstrained optimization: Gradient Descent method, Conjugate gradient method and Newton's method,Penalty function method

Constrained optimization: Lagrange's method and Kuhn-Tucker conditions

Self-Learning Topics (SLTs): *Additional problems on PCA [Text 3: topic 10, Example 10.4], Additional problems on Gradient Descent method[Text 4: topic 6.9,Practice problems: exercise-6.23], Additional problems on Conjugate gradientmethod [Text 4: topic 6.10, Practice problems: exercise-6.24], Additional problems on Newton's method [Text 4: topic 6.11, Practice problems: exercise-6.20], Additional problems on onLagrange's method[Text 4: topic 2.4.3, Solved problem: 2.9, 2.11, Practice problems: exercise-2.48, 2.49], Additional problems on Kuhn-Tucker conditions[Text 4: topic 2.5.1, Solved problem: 2.13, Practice problems: exercise-2.61, 2.62, 2.63],*

CourseLearningOutcomes (COs):

After completion of this course, the students should be able to…

CO1: apply linearalgebra and multivariate calculus conceptsto solve real-worldsituations.

CO2: analyze the data using various statistical measures andprobabilitydistributions

CO3: applyexactsamplingdistributionsintestingofhypothesis.

CO4: analyze dimensionality reduction with PCA and optimize the function using various methods of optimization

Text Book(s):

1. S.C. Gupta V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 10th ed., New Delhi: Sultan Chand &Sons Educational Publishers, 2010.
2. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong., *Mathematics for Machine Learning*, 1st ed., UK: Cambridge University Press, 2020.
3. Bernard KolmanandDavid R.Hill.,*Introductory linear algebra an applied first course*, London, UK: Pearsoneducation
4. S.S.Rao, *Engineering Optimization theory and practice*, 4th ed., Hoboken, New Jersey John Wiley & Sons, Inc., 2009

Reference Book(s):

1. G. Strang, *Introduction to Linear Algebra*, 6th ed., MA, USA: Wellesley-Cambridge Press, 2023
2. B.L.S. Prakasa Rao., *A first course in Probability and statistics*, 1st ed., Singapore: World Scientific Publishing Co. Pvt. Ltd., 2009
3. S. P. Gupta, *Statistical Methods*, 46th ed., New Delhi: Sultan Chand& Sons, 2021
4. J.C.Pant, *Introduction to Optimization (OperationsResearch*), 7th ed., New Delhi: JainBrothers, 2008

Web and Video link(s):

1. https://www.youtube.com/watch?v=JO9jNe6BemE&list=PLLy_2iUCG87D1CXFxE-SxCFZUiJzQ3IvE:

   NPTEL Video Lecture on ESSENTIAL MATHEMATICS FOR MACHINE LEARNING/ Prof.S.K.Gupta and Prof. Sanjeev kumar /IIT Roorkee.
2. https://www.youtube.com/watch?v=r1sLCDA-kNY&list=PL46B9EA2CFEB51241:

   NPTEL Video Lecture on Introduction to the Theory of Probability/Prof.M.Chakraborty /IIT Kharagpur.

Course Articulation Matrix (CAM):		**U24MH301E: ESSENTIAL MATHEMATICS AND STATISTICS FOR MACHINE LEARNING**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24MH301E.1**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO2	**U24MH301E.2**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO3	**U24MH301E.3**	2	2	1	1	-	-	-	1	1	-	1	2	1
CO4	**U24MH301E.4**	2	2	1	1	-	-	-	1	1	-	1	2	1
U24MH301E		**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**2**	**1**

ADVANCED DATA STRUCTURES

Class: B.Tech. III – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI302**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: organizing and retrieving the data using binary tree, binary search trees
LO2: organizing and retrieving the data using AVL trees, B-Trees, red black trees and splay trees
LO3: organizing and retrieving the data using interval tree, hash tree, tries, sorting and searching
LO4: organizing and retrieving the data using graphs and spanning trees

THEORY COMPONENT

UNIT-I — 9 Hrs

Trees: Introduction, Types of trees

Binary Tree: Creating a binary tree, Traversing a binary tree: Preorder, Inorder, Postorder and Spiral order recursive traversals

Binary Search Tree: Operations - Insertion, Deletion, Search, Recursive and non-recursive traversal, Threaded binary trees

Self Learning Topics (SLTs): *Linear representation of a Binary Tree, Threaded binary trees applications (Text1: Chapter 7), Review questions, Debugging exercises, Programming exercises, Interview questions (Text1: Chapter 7, Text2: Chapter 9-10)*

UNIT-II — 9 Hrs

AVL Trees: AVL trees operations - Insertion, Deletion and Traversal

Red-Black Trees: Properties, Operations, Applications, Splay trees

Multiway Search Trees: Introduction to m-way search trees, Operations on B-Trees-Insertion, Deletion, Search, B+-Trees

Self Learning Topics (SLTs): *AVL Tree search operation, B+-Tree deletion, Applications of AVL Tree, Red black tree, B-Tree and B+-Tree (Text1: Chapter 7), Applications of AVL Tree, (Text2: Chapter 10) , Review questions, Programming exercises, Interview questions (Text1: Chapter 7, Text2: Chapter 10)*

UNIT-III — 9 Hrs

Interval Tree, Hash tree

Tries: Trie structure, Operations on Tries, Applications of Trie indexing

Searching and Internal Sorting: Fibonacci search, Quick sort, Merge sort, Heap sort, Bitonic generator sort, Time complexities of above searching and sorting techniques

Self Learning Topics (SLTs): *Heap tree, Applications of Heap (Text1: Chapter7), Review questions, Debugging exercises, Programming exercises, Interview questions (Text1: Chapter 7, chapter 10, Text2: Chapter 14)*

UNIT-IV	9 Hrs

Graphs: Introduction, Graph terminology, Representation of graphs

Application of Graph Structures: Topological sorting, Minimum spanning trees: Prim's algorithm, Kruskal's algorithm, Graphs traversal methods - Breadth first search, Depth first search, Kosaraju's algorithm

String manipulations, String compression - Run length encoding

String Matching Algorithms: Naive algorithm, Knuth Morris Pratt Algorithm, Boyer Moore algorithm, Rabin Karp algorithm

Self Learning Topics (SLTs): *Applications of graphs (Text1: Chapter 9), String manipulations (Text2: Chapter 4), Review questions, Debugging exercises, Programming exercises, Interview questions (Text1: Chapter 9, Text2: Chapter 4)*

LABORATORY COMPONENT

List of Experiments

1. Develop a program to perform creation, insertion, traversal operations on binary trees.
2. Develop a program to perform creation, deletion, traversal (recursion) operations on binary search tree.
3. Develop a program to perform inorder, preorder and postorder operations on binary search tree traversal without recursion.
4. Develop a program to implement AVL tree construction.
5. Develop a program to implement B-tree construction.
6. Develop programs on Trie and Fibonacci search.
7. Develop programs on Quick sort and Merge sort.
8. Develop programs on Heap sort and Bitonic generator sort.
9. Develop programs on Topological sort, Prim's algorithm and Kruskal's algorithm.
10. Develop programs on Depth first search, Breadth first search and Kosaraju's algorithm.
11. Develop programs on Naive and Knuth - Morris - Pratt (KMP) algorithms.
12. Develop programs on Boyer Moore and Rabin Karp algorithms.

Text Book(s):

1. Debasis Samanta, *Classic Data Structures*, 2nd ed., New Delhi: Prentice Hall India, 2009. *(Chapters 7, 8 & 9)*
2. Reema Thareja, *Data Structures Using C,* 3rd ed., New Delhi: Oxford University Press, 2023. *(Chapters 4, 9-14)*

Reference Book(s):

1. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach with C*, 2nd ed., Noida: Cengage Learning, 2007.
2. Adam Drozdeck, *Data Structures and Algorithms in C++*, 4th ed., Boston: Cengage Learning, 2013.
3. Samir Kumar Bandyopadhyay and Kashi Nath Dey, *Data Structures Using C*, 1st ed., Noida: Pearson, 2009.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms,* 4th ed., London: The MIT Press Cambridge, 2022.

<u>Web and Video link(s):</u> 1. https://onlinecourses.swayam2.ac.in/cec25_ma15 *NPTEL Video Lecture on Data Structures by Dr. M. Deivamani, Assistant Professor of IT, Anna University.* 2. https://onlinecourses.swayam2.ac.in/nou23_cs13 *NPTEL Video Lecture on Data Structure using C Programming by Dr. Dipti Verma, Professor of CSE, Chhattisgarh Swami Vivekanand Technical University, Chhattisgarh.*
<u>Laboratory Manual</u> (for laboratory component): 1. *Advanced Data Structures Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW
Course Learning Outcomes (COs) *<u>After completion of this course, the students should be able to,</u>* *<u>(based on cognitive skills acquired from theory component)</u>* **CO1 :** apply binary tree and binary search tree operations to construct, traverse and manage hierarchical data structures efficiently **CO2 :** utilize AVL, Red-Black, Splay and B-Trees to efficiently perform insertion, deletion and search operations in multi-level indexed data structures **CO3 :** apply Interval Trees, Hash Trees and Tries for efficient indexing, evaluate the time complexities of various searching and sorting algorithms **CO4 :** make use of graph algorithms and string matching techniques for efficient data processing and compression *<u>(based on psychomotor skills acquired from laboratory component)</u>* **CO5 :** develop and test programs for creation, insertion, deletion, and traversal operations on binary and binary search trees to efficiently manage and process hierarchical data **CO6 :** develop and test programs to implement AVL tree and B-tree for efficient data retrieval and multi-level indexing in optimized management **CO7 :** develop and test programs on Trie, Fibonacci search, Quick sort, Merge sort, Heap sort and Bitonic generator sort to efficiently handle data searching and sorting operations **CO8 :** develop and test programs on graph algorithms like topological sort, Prim’s algorithm, Kruskal’s algorithm, DFS, BFS and Kosaraju’s algorithm, string matching algorithms like Naive, KMP, Boyer-Moore and Rabin-Karp for efficient problem solving

Course Articulation Matrix (CAM):				U24AI302 : ADVANCED DATA STRUCTURES										
CO		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	U24AI302.1	2	2	2	2	-	-	1	1	1	-	1	2	2
CO2	U24AI302.2	2	2	2	2	-	-	1	1	1	-	1	2	2
CO3	U24AI302.3	2	2	2	2	-	-	1	1	1	-	2	2	2
CO4	U24AI302.4	2	2	2	2	-	-	1	1	1	-	2	2	2
CO5	U24AI302.5	1	1	2	2	1	-	1	1	1	2	2	1	1
CO6	U24AI302.6	1	1	2	2	1	-	1	1	1	2	2	1	1
CO7	U24AI302.7	1	1	2	2	1	-	1	1	1	2	2	1	1
CO8	U24AI302.8	1	1	2	2	1	-	1	1	1	2	2	1	1
U24AI302		**1.5**	**1.5**	**2**	**2**	**1**	**-**	**1**	**1**	**1**	**2**	**1.75**	**1.5**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

OPERATING SYSTEMS

Class: B.Tech. III - Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI303**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-5-8**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basics of operating system, system structure and process

LO2: cpu scheduling, process synchronization and deadlocks
LO3: main memory, virtual memory and mass-storages

LO4: protection techniques and advantages of distributed system

UNIT-I	**9 Hrs**

Introduction: What operating systems do, Computer system architecture, Operating system operations, Process management, Memory management, Storage management, Protection and security, Computing environments

Operating System Structures: Operating system services, System calls, Types of system calls, System programs, Operating system structure, System boot

Processes: Process concept, Process scheduling, Inter process communication

Case study: The Linux System – Overview of its architecture, Process management, Memory management, File system, and System calls

Self Learning Topics (SLTs): *Virtualization (Text1: topics 1.7), Multithreading models (Text1: Chapter 4.3)*

UNIT-II	**9 Hrs**

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms– First come first served, Shortest job first, Priority, Round robin, Multilevel queue, Multilevel feedback queue

Process Synchronization: Background, The critical section problem, Petersons' solution, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Monitors

Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock

Self Learning Topics (SLTs): *Modern CPU scheduling techniques including advanced multi-core and real-time scheduling algorithms (Text1: Chapter 5.5), Practice exercises on resource-allocation graphs and deadlock avoidance using banker's algorithm. (Text1: Practice exercise 8.12 – 8.18)*

UNIT-III	**9 Hrs**

Main Memory: Background, Swapping, Contiguous memory allocation, Segmentation, Paging

Virtual Memory: Background, Demand paging, Page replacement, Allocation of frames, Thrashing
Mass-Storage Structure: Overview of mass storage structure, Disk structure, Disk scheduling

Self L*earning Topics (SLTs): Structure of the page table (Text1: Chapter 9.4)*, *RAID* structure *(Text1: Chapter 11.8), Practice exercises on page replacement algorithms (Text1: Practice exercise 10.1 – 10.9).*

UNIT-IV	9 Hrs

File-System Interface: File concept, Access methods, Directory and disk structure

File-System Implementation: Allocation methods, Free-space management

Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix

Distributed Systems: Advantages of distributed systems, Types of network-based operating systems, Communication structure, Robustness
Self Learning Topics (SLTs): *File-system structure (Text1: Chapter 14.1)*

Course Learning Outcomes (COs):
After completion of this course, the students should be able to…

CO1: A apply the fundamental concepts of operating system and processes to solve the essential problems related to operating systems
CO2: analyze CPU scheduling based on throughput, turnaround time, waiting time, and CPU utilization, evaluate process synchronization using mutual exclusion, progress, and bounded waiting, along with deadlock conditions and prevention
CO3: analyze page replacement algorithms based on page fault rate and hit ratio, evaluate disk scheduling algorithms based on seek time, rotational latency and transfer time for effective memory and storage management
CO4: design the secured distributed systems using the concepts of protection methods and distributed systems

Text Book(s):

1. Abraham Silberschatz, Peter B Galvin, Gerg Gagne, *Operating System Concepts*, Global ed., USA: Wiley, 2024. (*Chapters 1 to 11, 13 to 14 ,17 ,19*)

Reference Book(s):

1. EktaWalia, *Operating Systems*, 2nd ed., New Delhi: Khanna Publishing House, 2019.
2. William Stalling, *Operating Systems*, 9th ed., USA: Pearson, 2018.
3. Dhananjay M. Dhamdhere, *Operating Systems A Concept-Based Approach*, 3rd ed., New Delhi: McGraw Hill, 2017.
4. Andrew S. Tanenbaum, Herbert BOS, *Modern Operating Systems*, 4th ed., USA: Pearson, 2016.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs108/preview, *NPTEL Video Lecture on Operating System Fundamentals by Prof. Santanu Chattopadhyay, IIT Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc23_cs101/preview, NPTEL *Video Lecture on Introduction to Operating Systems by Prof. Chester Rebeiro IIT Madaras.*

Course Articulation Matrix (CAM):		U24AI303 : OPERATING SYSTEMS												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI303.1**	2	2	2	2	-	1	1	1	1	2	2	2	2
CO2	**U24AI303.2**	2	2	2	2	-	1	1	1	1	2	2	2	2
CO3	**U24AI303.3**	2	2	2	2	-	1	1	1	1	2	2	2	2
CO4	**U24AI303.4**	2	2	2	2	-	1	1	1	1	2	2	2	2
U24AI303		**2**	**2**	**2**	**2**	**-**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

AUTOMATA THEORY AND COMPILER DESIGN

Class: B.Tech. III -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI304**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-1-0-4-7**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: basics concepts of formal languages, grammars and automata theory
LO2: design and analysis of regular expressions and context-free grammars
LO3: computational models, including pushdown automata and Turing machine
LO4: phases of a compiler, apply parsing techniques and translation schemes

UNIT-I	9 Hrs

Introduction to Finite Automata: Structural representations, Automata and complexity, The central concepts of automata theory – Alphabets, Strings, Languages, Problems

Nondeterministic Finite Automata: Formal definition, An application, Text search, Finite automata with epsilon-transitions

Deterministic Finite Automata: Definition of DFA, How A DFA process strings, The language of DFA, Conversion of NFA with €-transitions to NFA without €-transitions, Conversion of NFA to DFA, Moore and Melay machines

Self Learning Topics (SLTs): *Minimization of DFA (Text1: Topics: 4.4.3)*

UNIT-II	9 Hrs

Regular Expressions: Finite automata and regular expressions, Applications of regular expressions, Algebraic laws for regular expressions, Conversion of finite automata to regular expressions

Pumping Lemma for Regular Languages: Statement of the pumping lemma, Closure properties of regular languages

Context-Free Grammars: Definition of context-free grammars, Derivations using a grammar, Leftmost and rightmost derivations, The language of a grammar, Parse trees, Ambiguity in grammars and languages, Removal of ambiguity in grammars, Pumping lemma of context-free languages, Simplification of CFG, Chomsky normal form (CNF)

Self Learning Topics (SLTs): *applications of regular expressions (Text1: Topics: 3.3), applications of pumping lemma (Text1: Topics: 4.1.2)*

UNIT-III	9 Hrs

Push Down Automata: Definition of the pushdown automaton, The languages of a PDA, Equivalence of PDA and CFG, Acceptance by final state, Acceptance by empty store

Turing Machines: Introduction to turing machine, Formal description, Instantaneous description, The language of a turing machine

Undecidability: Undecidability, A language that is not recursively enumerable, An undecidable problem that is RE, Undecidable problems about turing machines, Post-correspondence problem

Self Learning Topics (SLTs): *Recursive languages and recursively enumerable languages (Text1: Topics: 9.2.1)*

UNIT-IV	9 Hrs
Introduction: The structure of a compiler **Lexical Analysis**: The Role of the lexical analyzer, Input buffering, Recognition of tokens **Syntax Analysis**: Top-down parsing, Bottom-up parsing, Introduction to LR parsing: Simple LR, More powerful LR parsers **Syntax-Directed Translation**: Syntax-directed definitions, Evaluation orders for SDD's, Syntax directed translation schemes **Intermediate-Code Generation**: Intermediate languages, Three-address code **Run-Time Environments**: Stack allocation of space, Access to nonlocal data on the stack ***Self Learning Topics (SLTs):*** *Syntax trees (Text 2: Topics: 4.4), Heap Management (Text2: Topics: 7.4)*	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply the concepts of finite automata to model and solve basic computational problems

CO2: apply regular expressions and context-free grammars to develop and analyze formal languages

CO3: analyze computational models like pushdown automata and turing machines to classify languages and understand the limits of computation through undecidability

CO4: analyze the phases of a compiler and apply syntax analysis, intermediate code generation, and code optimization techniques

Text Book(s):

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, *Introduction to Automata Theory, Languages, and Computation*, 3rd ed., New Delhi: Pearson Education, 2006. *(Chapters 1-9)*
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, *Compilers: Principles, Techniques and Tools,* 2nd ed., New Delhi: Pearson, 2014.(*Chapters: 1, 3-8*)

Reference Book(s):

1. Michael Sipser, *An Introduction to the Theory of Computation*, 3rd ed., USA: Cengage Learning, 2012.
2. Peter Linz, Jones, An *Introduction to Formal Languages and Automata*, 6th ed., Burlington, Massachusetts: Barlett Learning, 2017.
3. Kenneth C. Louden, Thomson, *Compiler Construction*, International ed., Boston: Course Technology Inc, Massachusetts, 1997.
4. Mishra and Chandrashekaran, *Theory of Computer Science – Automata languages and computation*, 3rd ed., New Delhi: PHI, 2008.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs83/preview, *NPTEL Video Lecture on Theory of Computation by Prof. Raghunath Tewari, IIT Kanpur.*
2. https://onlinecourses.nptel.ac.in/noc21_cs07/preview, *NPTEL Video Lecture on Compiler Design by Prof. Santanu Chattopadhyay, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24AI304 : AUTOMATA THEORY AND COMPILER DESIGN											
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI304.1**	2	2	2	1	-	1	-	1	1	1	1	1	1
CO2	**U24AI304.2**	2	2	2	1	-	1	-	1	1	1	1	1	1
CO3	**U24AI304.3**	2	2	2	1	-	1	-	1	1	1	2	1	1
CO4	**U24AI304.4**	2	2	2	1	-	1	-	1	1	1	2	1	1
U24AI304.1		**2**	**2**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**1**	**1.5**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Class: B.Tech.III –Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI305**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**60 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: programming paradigmsand basic java constructs including data types, controlstructures, and classes
LO2: classes, constructors, different types of methodsand strings manipulations
LO3: inheritance, dynamic method dispatch, interfaces and packages
LO4: using I/O, file handling, exception handling and multi-threading

THEORY COMPONENT

UNIT-I	**9 Hrs**

Programming Paradigms: Procedural programming, Modular programming, Object oriented programming (OOP), Generic programming

The History and evolution of Java: Java's Lineage, The Creation of Java, How Java changed the internet, Java's Magic: The Byte Code, The Java buzzwords, The evaluation of Java

An overview of java: Object Oriented Programming, OOP principles, A first simple program

Data types, Variables and arrays: Java is strongly typed language, The primitive types, Integers, Floating-point types, Characters, Booleans, A closer look at literals, Variables, Type Conversion and casting, Automatic type promotion in expressions, Arrays, One dimensional arrays, multi-dimensional arrays, Jagged arrays,

Operators: Arithmetic operators, The bitwise operators, Relational operators, Boolean logical operators, Short-circuit logical operators, The assignment operator, The ? operator, Operator precedence, Using parenthesis

Control statements: Selection statements, Iteration statements, The for-each version of the for loop, Nested loops, Jump statements,

Introducing Classes: Class fundamentals, Declaring Objects, Assigning object reference variables, Introducing Methods

Self Learning Topics (SLTs):*Lexical Issues like Keywords, identifiers, Literals and comments (TextBook-Chapter 2), Type conversions and casting (TextBook-Chapter3)*

UNIT-II	**9 Hrs**

Classes and Methods: Constructors, The *this* keyword, Garbage collection, Overloading methods, Overloading constructors, Using objects as parameters, A closer look at argument passing, Returning objects, Recursion, Introducing access control, Understanding static,

Static blocks, Static methods, Introducing final, Arrays revisited, Introducing nested and inner classes, Using command-Line arguments, Varargs: Variable length arguments, Overloading vararg methods, Varargs and ambiguity, Wrapper classes

Strings: Exploring String class and its methods, StringBuffer, StringBuilder and StringTokenizer classes

Self Learning Topics (SLTs): *Overloading Vararg Methods, Varargs and Ambiguity(TextBook-Chapter: 7),Anonymous Inner classes(TextBook-Chapter-25),*

UNIT-III	9 Hrs

Inheritance: Inheritance basics, Types of inheritance, Member access and inheritance, A super class variable can reference a subclass object, Using *super*, When constructors are executed, Method overriding, Dynamic method dispatch, Using abstract classes, Using *final* with inheritance, Object class

Interfaces: Defining an interface, Implementing interfaces, Nested interfaces, Variables in interfaces, Interfaces can be extended

Packages: Defining a package, Finding packages and CLASSPATH, Packages and Member Access, Importing packages

Self Learning Topics (SLTs): *Accessing Implementations Through Interface References*, *Default interface methods,Use static Methods in an Interface, private interface methods (TextBook -Chapter-9)*

UNIT-IV	9 Hrs

Using I/O: I/O basics, Streams, Byte streams and character streams, Reading console input, Writing console output, Reading, Writing and copying files using byte and character streams

Exception Handling: Fundamentals, Exception types, Uncaught exceptions, Using *try* and *catch*, Multiple catch clauses, Nested try statements, *throw*, *throws*, *finally*, Java's built-in exceptions, Creating your own exception sub classes

Multithreading: The java thread model, Thread priorities, The main thread, Creating a thread, Creating multiple threads, Using isAlive() and join(), Thread priorities, Synchronization, Interthread communication, Suspending, Resuming, and stopping threads, Obtaining a thread state, Using a factory method to create and start a thread

Self Learning Topics (SLTs):*try-with resource, multi catch, chained exception, precise re-throw(TextBook-Chapter:10), Serialization- Writing and reading objects to and from the file-(TextBook-Chapter-22)*

List of Experiments

Experiment-I:

1. Develop a java program to demonstrate different operators in java.
2. Develop a java program to demonstrate control structures.
3. Develop a java program to demonstrate *switch* statement.

Experiment-II:

1. Develop a java program to read an array and display them using *for-each* control. Finally display the sum of array elements.
2. Develop a java program to read a matrix and display whether it is an identity matrix or not. Use *civilizedform* of *break* statement.
3. Develop a java program to define a two-dimensional (2D) array where each row contains different numberof columns. Display the 2D-array using *for-each*.

Experiment-III:

1. Develop a javaprogram to demonstrate class concept
2. Develop a java program to demonstrate *this keyword*
3. Develop a java program to demonstrate object reference variable
4. Develop a java program to demonstrate overloading of methods
5. Develop a java program to demonstrate passing and returning objects

Experiment-IV:

1. Develop a java program to demonstrate variable length argument (using array and ellipsis notation).
2. Develop a java program to demonstrate constructors and garbage collection.
3. Develop a java program to demonstrate nested and inner classes.
4. Develop a java program to demonstrate *static*variables, *static*methods, and staticblocks.

Experiment-V:

1. Read at least five strings from command line argument and display them in sorted order.
2. Develop a java program to demonstrate wrapper class by reading N number of integers from command line and display their sum.
3. Develop a java program to demonstrate wrapper class by reading N floating point numbers from command line and display their average.

Experiment-VI:

1. Develop a java program to accept a string, count number of vowels and remove all vowels.
2. Develop a java program to accept a string, count number of vowels and remove all vowels using *StringBuffer*class**.**
3. Develop a javaprogram to accept a line of text, tokenize the line using *StringTokenizer* class and print the tokens in reverse order.

Experiment-VII:

1. Develop a java program to demonstrate single level-inheritance.
2. Develop a java program to demonstrate multilevel inheritance using super.
3. Develop a java program to demonstrate method overriding.

Experiment-VIII:

1. Develop a java program to demonstrate dynamic method dispatch.
2. Develop a java program to demonstrate use of abstract class.
3. Develop a java program to demonstrate the use of overriding *equals()* method of an Object class.

Experiment-IX:

1. Develop a java program to implement interfaces.
2. Develop a java program to extend the interfaces
3. Develop a java program to demonstrate implementation of nested interfaces.

Experiment-X:

1. Develop a java program to create a *package* anddemonstrate to import the*package* into any java program (Consider the behaviour of all access specifiers).

Experiment-XI:

1. Develop a java program to demonstrate *try-catch* block.
2. Develop a javaprogram to demonstrate *throw* clause.
3. Develop a java program to demonstrate *throws* clause.
4. Develop a java program to demonstrate *re-throw*an exception and *finally* block.

Experiment-XII:

1. Develop a java program to demonstrate read/write/copy a file using *byte stream*.
2. Develop a javaprogram to demonstrate read/write/copy a file using *character stream*.
3. Develop a java program to create a thread (using *Thread* class or *Runnable* interface).
4. Develop a java program to demonstrate *synchronization* of threads.
5. Develop a java program to demonstrate *Inter-threadcommunication*.

Text Book(s):

1. HerbertSchildt, *Java TheComplete Reference*, 13th ed., New Delhi:McGraw-Hill Education, 2019.

Reference Book(s):

1. Balaguruswamy, *Programming with Java: A Primer*, 7th ed., New Delhi:McGraw-Hill Education India Pvt. Ltd., 2019.
2. KathySierra, BertBates, *Head First Java*, 2nd ed., Boston:O'Reilly Publications,2005.
3. Harvey Deitel, Paul J. Deitel, *Java How to Program,* 11thed., New Delhi:Pearson Publications,2018.

Web and Video link(s):

1. https://nptel.ac.in/courses/106105191 NPTEL *Video Lecture onJava Programming*by Prof. Debasis Samanta,Professor of CSE,IIT Kharagpur.

Laboratory Manual (for laboratory component):

1. *Object Oriented Programming through java Manual and Record Book,* Department of CSE(AI & ML), KITSW.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: distinguish between various programming paradigms and develop fundamental java programs

CO2: develop java programs using classes, constructors, methods and various string handling techniques

CO3: apply inheritance, interfaces, and packages to build modular, maintainable, and reusable java applications

CO4: analyze and implement robust file I/O operations, exception handling mechanisms, and multithreading to create efficient and fault-tolerant java applications

CO5: develop and test simple java programs demonstrating the use of basic syntax, data types, control structures, and class fundamentals

CO6: develop and test java programs implementing method overloading, constructors, static members, and string manipulation techniques

CO7: use the reusability concepts like inheritance, dynamic method dispatch, interfaces and packages to develop and test modular, reusable and organized code

CO8: develop and test java programs using I/O, file handling, exception handling and multithreading to develop efficient and robust applications

Course Articulation Matrix (CAM):				**U24AI305 : OBJECT ORIENTED PROGRAMMING THROUGH JAVA**									
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI305.1**	2	2	2	-	-	-	1	1	1	-	2	1	1
CO2	**U24AI305.2**	2	2	2	1	-	-	1	1	1	-	2	1	1
CO3	**U24AI305.3**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO4	**U24AI305.4**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO5	**U24AI305.5**	1	1	1	1	1	-	1	1	1	-	2	1	1
CO6	**U24AI305.6**	1	2	2	2	1	-	1	1	1	-	2	1	1
CO7	**U24AI305.7**	1	2	2	2	1	-	1	1	1	-	2	2	2
CO8	**U24AI305.8**	1	2	2	2	1	-	1	1	1	-	2	2	2
U24AI305		**1.5**	**1.8**	**1.8**	**1.7**	**1**	**-**	**1**	**1**	**1**	**-**	**2**	**1.5**	**1.5**

SOFT AND INTERPERSONAL SKILLS LABORATORY

Class: B.Tech. III -Semester		**Branch:** Common to all Branches	
Course Code:	**U24VA306B**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE**	**100 %**
Total Number of Teaching Hours:	**24 Hrs**	**ESE**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: analysing self and learning to overcome possible threats

LO2: group dynamics to demonstrate respect for the opinions and beliefs of group

LO3: effective presentations using visual aids and analyzing the videos

LO4: communicating professionally, making resume in line with industry expectations

LIST OF ACTIVITIES

Activity 1	Ice-breaking, Self-Awareness and Just a Minute (JAM)
Activity 2	Self-Introduction & Personal SWOT Analysis
Activity 3	Reading Comprehension & Critical Thinking
Activity 4	Active Listening & Non-Verbal Observation (Video + Peer Practice)
Activity 5	Group Discussion - 1
Activity 6	Resume Building & LinkedIn Profile Review
Activity 7	Group Discussion - 2
Activity 8	Presentation Skills with PPT / Storytelling
Activity 9	Group Discussion - 3
Activity 10	Mock Interviews: Technical & HR
Activity 11	Email Etiquette & Professional Communication
Activity 12	Workplace Etiquette & Conflict Resolution

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: deliver concise & effective self-introduction and demonstrate confidence, spontaneous speaking skills within a limited time

CO2: conduct a personal SWOT analysis to identify areas for self-improvement and career development

CO3: demonstrate clear & respectful communication, leadership, positive attitude and improve interpersonal relationship by actively participating in group discussions, collaborative tasks & mock interviews

CO4: create a professional resume, develop a LinkedIn profile and demonstrate effective video communication by making effective videos on self-introduction, personal SWOT analysis & spontaneous speaking activity along with email & workplace

etiquette
Text Book(s): 1. Krishna Mohan, Meera Benerji, *Developing Communications Skills*, 2nd ed., New Delhi: Mcmillan Publications, 2005

Course Articulation Matrix (CAM):				**U24VA306B : SOFT AND INTERPERSONAL SKILLS LABORATORY**										
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24VA306B.1**	-	-	-	-	-	-	-	2	3	-	1	-	-
CO2	**U24VA306B.2**	-	-	-	-	-	-	2	3	3	-	1	-	-
CO3	**U24VA306B.3**	-	-	-	-	-	-	-	2	3	-	1	-	-
CO4	**U24VA306B.4**	-	-	-	-	-	-	1	2	3	-	1	-	-
U24VA306B		-	-	-	-	**-**	-	**1.5**	**2.25**	**3**	**-**	**1**	**-**	-
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Programming Skill Development Lab-2

Class: B.Tech. II -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24SE307**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: fundamentals on data structures and their implementation with arrays

LO2: representation of data structures using stacks and various forms of queues

LO3: representing the data using various types of linked lists

LO4: various sorting techniques on the given data and representing different hashing techniques

LABORATORY COMPONENT

S. No.	List of Experiments
1.	a) Develop a C-program to shrink an array by removing triplets that satisfy given constraints. Given an integer array, shrink it by removing adjacent triplets that satisfy the given constraints and return the total number of elements in the resultant array. Input: A[] = [1, 2, 3, 5, 7, 8], k = 2 . Output: 3 b) Develop a C-program to find the maximum and minimum elements in an array. c) Develop a C-program to represent a sparse matrix using a 2D array
2.	a) Develop a C-program to allocate memory for an integer array dynamically and accept user's input. b) Implement a C-program to dynamically allocate a 2D matrix and take input from the user. c) Develop a function to free dynamically allocated memory after use
3.	a) To design and implement a web browser navigation system that mimics the behavior of modern browsers using two stacks to manage Back and Forward navigation using C-language. b) Implement a C- program to create and manage multiple stacks in a single array. c) Write a C-program to Convert an infix expression (e.g., (A + B) * C) to its postfix form using a stack.
4.	a) Develop a C-program to implement a circular queue using an array. b) Implement a C-program priority queue where elements are dequeued based on priority. c) Develop a C-program simulate a printer queue system where documents are printed in FIFO order.
5.	a) Write a C-program Tower of Hanoi using Iterative Stack: Solve the Tower of Hanoi problem using a stack instead of recursion

	b) Job Scheduling Simulation: Implement a C-program queue-based job scheduler where tasks are executed in FIFO order, but some high-priority jobs can be inserted at the front. c) Circular Queue without Extra Space: Implement a C-program circular queue without using extra space or an additional array.
6.	a) Given an array-based implementation and a linked list-based implementation of a list, compare the worst-case complexities for insertion, deletion, and search b) Design an efficient method to merge two sorted singly linked lists without using extra space. c) Consider a scenario where a linked list is frequently modified. How would you optimize memory usage during frequent insertions and deletions?
7.	a) Implement a C-programs on one dimensional array and two-dimensional arrays b) Develop a C-program to detect and remove a cycle in a singly linked list without using extra space. Hint: Use Floyd's Cycle Detection Algorithm (Tortoise and Hare approach). c) Given a circular linked list, implement a function to split it into two equal halves. If the list has an odd number of nodes, the first list should have one extra node. **Input**: 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> (back to 1) **Output**: Two lists: (1 ->2-> 3) and (4->5-> 6)
8.	a) Develop a function to remove all duplicate nodes from an unsorted singly linked list without using extra space (no hash set or array allowed). Input: 4 -> 2 -> 3 -> 2 -> 1 -> 3 Output: 4 -> 2 -> 3 -> 1 b) Given a linked list-based stack, implement a function to sort the stack in O(n log n) time using recursion without using extra space. c) Develop a C-program to find two odd occurring elements in an array without using any extra space given an integer array, duplicates appear in it an even number of times except for two elements, which appear an odd number of times. Find both odd appearing elements without using any extra memory. For example, Input: arr[] = [4, 3, 6, 2, 4, 2, 3, 4, 3, 3] Output: The odd occurring elements are 4 and 6 6 appears once. 2 appears twice. 4 appears thrice. 3 appears 4 times.
9.	a) Implement a C-program selection sort on a linked list instead of an array, achieving an in-place sorting mechanism. Follow-up: Optimize it to work in **$O(n^2)$** time without using extra space. b) Given an array of large floating-point numbers, implement Radix Sort to sort them efficiently. Example: Input: [3.141, 2.718, 1.414, 4.669] Output: [1.414, 2.718, 3.141, 4.669]
10.	a) Develop a C-program for given an array of integers, sort it using Insertion Sort but with the constraint that you can swap only adjacent elements and minimize the number of swaps. Example: Input: [8, 4, 2, 9] ,Output: [2, 4, 8, 9] (with minimum swaps) d) Given an array of integers, sort it using Insertion Sort but with the constraint that you can swap only adjacent elements and minimize the number of swaps. Example:

	Input: [8, 4, 2, 9] , Output: [2, 4, 8, 9] (with minimum swaps)
11.	a) Implement C-program for Shell Sort with a custom gap sequence that minimizes the worst-case complexity. Compare the performance of: i. Knuth's sequence ii. Hibbard's sequence iii. Original Shell's sequence Run the sort on an input of 1 million elements and report the execution time of each sequence. b) Write a C-program for Sort an array in one swap whose two elements are swapped given an array where all its elements are sorted in increasing order except two swapped elements, sort it in linear time. Assume there are no duplicates in the array. For example, Input: A[] = [3, 8, 6, 7, 5, 9] or [3, 5, 6, 9, 8, 7] or [3, 5, 7, 6, 8, 9] Output: A[] = [3, 5, 6, 7, 8, 9]
12.	a) Design a custom hash function for a dictionary that stores words and their meanings. Ensure minimal collisions when hashing large sets of words (e.g., 100,000 words). b) Implement Chaining (Open Hashing) using a binary search tree (BST) at each bucket instead of a linked list. Insert, Search, and Delete should work in O(log k) time, where k is the number of elements in a bucket.

Textbook(s):

1. Debasis Samanta, *Classic Data Structures*, 2nd ed., New Delhi: Prentice Hall India, 2009.
2. Reema Thareja, *Data Structures using C,* 2nd ed., New Delhi: Oxford University Press, 2022.
3. E Balagurusamy, *Data Structure using C*, 1st ed., Noida: McGraw Hill Education, Uttar Pradesh, 2017.

Reference Book(s):

1. Paul Deitel, Harvey Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, 9th ed., USA: Pearson Education Limited, 2022.
2. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach with C,* 2nd ed., USA: Cengage Learning, 2007.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to …

CO1: apply static & dynamic memory management for performing different operations using arrays

CO2: analyze the linear data structures stacks and queues in organizing the data.

CO3: organize and retrieve the data through various linked list representations in non-contiguous memory storage

CO4: compare different sorting techniques, hashing techniques for efficient utilization of data

Course Articulation Matrix (CAM):					**U24SE307 : Programming Skill Development Lab-2**									
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24SE307.1**	2	2	1	1	1	1	1	1	1	1	2	2	2
CO2	**U24SE307.2**	2	2	1	1	1	1	1	1	1	1	2	2	2
CO3	**U24SE307.3**	2	2	1	1	1	1	1	1	1	1	2	2	2
CO4	**U24SE307.4**	2	2	1	1	1	1	1	1	1	1	2	2	2
U24SE307		**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

PRACTICUM-3

Class: B.Tech. III –Semester	**Branch:** Common to all branches		
Course Code:	**U24EL309**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-4-4**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: literature review and identifying research gaps
LO2: implementing a project independently by applying knowledge to practice
LO3: preparingwell-documented report and informative PPT
LO4: effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:**In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

Course	U24MH301F	U24AI302	U24AI303	U24AI304	U24AI305	U24VA306B
Students allotted to different	B24XX001	B24XX011	B24XX021	B24XX031	B24XX041	B24XX051
	B24XX002	B24XX012	B24XX022	B24XX032	B24XX042	B24XX052
	B24XX003	B24XX013	B24XX023	B24XX033	B24XX043	B24XX053

courses	B24XX004	B24XX014	B24XX024	B24XX034	B24XX044	B24XX054
	B24XX005	B24XX015	B24XX025	B24XX035	B24XX045	B24XX055
	B24XX006	B24XX016	B24XX026	B24XX036	B24XX046	B24XX056
	B24XX007	B24XX017	B24XX027	B24XX037	B24XX047	B24XX057
	B24XX008	B24XX018	B24XX028	B24XX038	B24XX048	B24XX058
	B24XX009	B24XX019	B24XX029	B24XX039	B24XX049	B24XX059
	B24XX010	B24XX020	B24XX030	B24XX040	B24XX050	B24XX060

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

CIRCULAR

Allotment of Practicum topics to students

Section : ……….

S.No.	Roll number of the student	Practicum topic Allotted	Practicum under the course	Course faculty

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetableand alsooutside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum

during the semester course work.

(Signature of class teacher)

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix).

(x). A sample rubrics for assessment and evaluation of practicum is as follows:

Literature survey & Identification of research gaps	10 marks
Working model / process / software package / system developed	30 marks
Report writing (subjected to max of 30% plagiarism)	20 marks
Oral presentation with PPT and viva-voce	20 marks
Video pitch	20 marks
Total	100 marks

<u>Note</u>: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process /

system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggestfor addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicumreport should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacheras per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce

ii) he/she fails to submit the report in prescribed format

iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: synthesize literature survey, identify research gaps anddefine objective & scope of practicum problem

CO2: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

CO3: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

CO4: create a video pitch on practicum and make an effective oral presentation using PPTs

Course Articulation Matrix (CAM):		**U24EL309: PRACTICUM-3**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24EL309.1**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	**U24EL309.2**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	**U24EL309.3**	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	**U24EL309.4**	2	2	2	2	2	2	2	2	2	2	2	2	2
U24EL309		**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

SOCIAL EMPOWERMENT ACTIVITY-3 / SELF ACCOMPLISHMENT ACTIVITY-3 (SEA-3 /SAA-3)

Class: B.Tech. III Semester	**Branch:** Common to all branches		
Course Code:	**U24VA309 (SE/SA)ZZZ**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: holistic development through activity-based learning to gain real-life experiencewhicheffectively help individualsdeal appropriately with problems/challenges

LO2: positive mindset by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

LO3: skills for effective fieldwork practice, which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

LO4: making a well-documented report and an effective oral presentationthrough PPTs portraying knowledge, skills,qualitiesacquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) isintroduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual andsocial aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses,which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (SelfAccomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student

develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester,through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

Monitoring SEA/SAA:

(a) **Nodal units:**The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i^{2}RE)shall act as nodal units for activities listed under SEA/SAA.

(b) During the semester period, the student has to**acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition& Skilling**:

  i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

  ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

  iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

  i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

iii. **As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

Eminent personalities/ Achievers / Renowned personalities:

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interacteminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders.Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:**The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentationand report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every studentshall, identifiesminimum of4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:***There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

Assessment	Maximum marks	Marks to be awarded by
Goal setting, Planning& Knowledge Acquisition	20	Nodal centre
Field work	40	Nodal centre
Demonstration/Presentation	20	Nodal centre
Report submission	20	Faculty counsellor
Total	**100**	**-**

Note:

(a) **Presentation/ Demonstration:**It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**

b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensibility

CO2: interact effectively through written, oral and nonverbal communication with external-world in a professional, sensitive and culturally relevant manner

CO3: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensibility

CO4: demonstrate the generic competencies in makinga well-documented report and an effective oral presentationwith PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

Text / Reference Book(s):

For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator

Course Articulation Matrix (CAM):		**U24VA309(SE/SA)ZZZ - Courses listed under SEA-3 /SAA-3**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24VA309.1**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO2	**U24VA309.2**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO3	**U24VA309.3**	-	-	-	-	-	2	2	2	2	2	2	1	1
CO4	**U24VA309.4**	-	-	-	-	-	2	2	2	2	2	2	1	1
U24VA309		**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Course Code: **U24VA309(SE/SA)ZZZ**

SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets

Ex: If A student selects a SEA/SAA course as below:	Ex: If A student selects a SEA/SAA course as below:
Semester: 1 *SEA/SAA course serial number: 09* *SEA/SAA category: SEA* *course number: 302* The **course code** will be U24VA109SE302	*Semester: 4* *SEA/SAA course serial number: 10* *SEA/SAA category: SAA* *course number: 206* The **course code** will be U24VA410SA206

EXPERT TALK SERIES–3

Class: B.Tech. III -Semester	**Branch:** Common to all branches		
Course Code:	**U24AE310**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-0-1-1**	**CIE Marks (%):**	**100**
Total Number of Teaching Hours:	**-**	**ESE Marks (%):**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: 21st century skills needed for industry, current industry trends, challenges and innovations

LO2: latest technology in practice andapplying knowledge to solve real-world problems

LO3: smart work, soft skills, professional etiquette, networking abilities

LO4: making a well-documented reportportraying the knowledge, skills, qualities acquired and the impact of the learning

In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples,is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d)Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

But how would you know all this without venturing into the industry?

(e) The answer is Industry**Expert Talk Series (ETS)**.Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21^{st} century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode**by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks(10 MCQs/FiBs;*duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:**At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:**There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

Rubrics for evaluation of ETS

Quiz score (*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*)	60 marks
Attendance (*out of 10 quizzes*)	20 marks
Report in prescribed format (*max 30% plagiarism*)	20 marks
Total	100 marks

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

ii. **Supplementary Exam:**

(i) Student has to register for ETS supplementary examination if he/she scores less than 40 marksin CIE

(ii) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks(MCQs/FiBs ; *duration: 2Hrs*)on the content covered in ETS lectures.

(iii) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(iv) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

CO2: identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

CO3: interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

CO4: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

Course Articulation Matrix (CAM):		**U24AE310 : EXPERT TALK SERIES-3**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AE310**.1	1	1	1	1	1	1	2	1	2	1	2	1	1
CO2	**U24AE310**.2	1	1	1	1	1	1	2	1	2	1	2	1	1

CO3	**U24AE310**.3	1	1	1	1	1	1	2	1	2	1	2	1	1
CO4	**U24AE310**.4	1	1	1	1	1	1	2	1	2	1	2	1	1
U24AE310		**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

Semester -IV

Syllabi

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

IV SEMESTER

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	PCC	U24AI401	Database Management Systems	2	1	-	3	3
2	PCC	U24AI402	Artificial Intelligence	2	1	-	3	3
3	PCC	U24AI403	Software Engineering	2	1	-	3	3
4	PCC	U24AI404	Computer Networks	2	1	-	3	3
5	PCC	U24AI405	Python Programming	2	1	-	3	3
6	VAC	U24VA406B	Quantitative Aptitude and Logical Reasoning	2	-	-	2	2
7	SEC	U24SE407	Programming Skill Development (PSD) Lab-3	-	-	2	2	1
8	PCC	U24AI408	Database Management Systems Laboratory	-	-	2	2	1
9	PCC	U24AI409	Python Programming Laboratory	-	-	2	2	1
10	VAC*	U24CY411*	Environmental Studies*	2*	-	-	2*	-
			Total:	12	5	6	23	20
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				NIL				

**For Lateral Entry Students Only*

DATABASE MANAGEMENT SYSTEMS

Class: B.Tech. IV–Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI401**	**Credits :**	**3**
Hours/Week (L-T-P-E)	**2-1-0-3**	**CIE :**	**60 %**
Total Number of Teaching Hours:	**36 Hrs**	**ESE :**	**40 %**

CO1 : apply relational data models and constraints for designing effective database

CO2 : design the databases using ER and ERR model

CO3 : design the database by using normalization techniques to reduce redundancy

CO4 : apply locking techniques for concurrent transactions and to recover the database from failures

UNIT-I	9 Hrs

Databases and Database Users: Introduction, Characteristics of the database approach, Actors on the scene, Workers behind the scene, Advantages of using a DBMS, when not to use a DBMS

Database System Concepts and Architecture: Data models, Schemas and instances, Three- schema architecture and data independence, Database languages and interfaces, The database system environment, Classification of database management systems.

The Relational Data Model, Relational Database Constraints: Relational model concepts, Relational constraints and the Relational database schemas, Update operations and dealing with constraint violations

Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL

UNIT-II	9 Hrs

Data modeling using the Entity-Relationship Model: Using high-level conceptual data models for database design, Entity types, Entity sets, Attributes and keys, Relationships types, Relationship sets, Roles and structural constraints, Weak entity types, ER diagrams

Enhanced Entity-Relationship: Sub classes, Super classes and Inheritance, Specialization and generalization, Constraints and characteristics of specialization and generalization hierarchies.

Relational Database Design by ER and EER-to-Relational Mapping: Relational database design using ER-to-Relational mapping, Mapping EER model constructs to relations

UNIT-III	9 Hrs

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Boyce-Codd normal form, Algorithms for relational database schema design, Multivalued dependency and fourth normal form, Join dependencies and fifth normal form

The Relational Algebra and Relational Calculus: Basic relational algebra operations, Examples of queries in relational algebra, The tuple relational calculus

Query Processing and Optimization: Translating SQL queries into relational algebra, Using heuristics in query optimization

UNIT-IV	9 Hrs

Introduction to Transaction Processing Concepts and Theory: Introduction to transaction processing, Transaction and system concepts, Desirable properties of transactions, Characterizing Schedules Based on Serializability

Concurrency Control Techniques: Two-Phase Locking techniques for concurrency control, Concurrency control based on Timestamp Ordering

Database Recovery Techniques: Recovery concepts, NO-UNDO/REDO Recovery Based on deferred update, Recovery techniques based on immediate update, Shadow paging.

Database Security and Authorization: Introduction to database security issues, Discretionary access control based on granting and revoking privileges, Mandatory Access Control and Role Based Access Control for Multilevel Security

Text Book(s):

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, 7th edition, 2017, New Delhi.

Reference Book(s):

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Education, 3rd edition, 2002, New York.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw-Hill Education, 3rd edition, 1997, New York.
3. Thomas Connolly, Carolyn Begg, Database Systems, Pearson Education, 3rd edition, 2003, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_cs91/preview; *NPTELVideo Lecture: DataBase Management System by Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur.*

Course Articulation Matrix (CAM):		**U24AI401 DATABASE MANAGEMENT SYSTEMS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI401.1**	2	2	2	2	-	-	-	-	-	1	-	2	1
CO2	**U24AI401.2**	2	2	2	2	-	-	-	-	-	1	-	3	1
CO3	**U24AI401.3**	2	2	2	2	-	-	-	-	-	1	-	2	1
CO4	**U24AI401.4**	2	2	2	2	-	-	-	-	-	1	-	3	1
U24AI401		**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2.5**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply relational data models and constraints for designing effective database	SDG9	Industry, Innovation and Infrastructure	Relational models and constraints help in building **robust and scalable database systems**, which are essential for modern digital infrastructure and innovation.
CO2	Design the databases using ER model	SDG4	Quality Education	ER modeling supports **structured data design**, which is widely used in educational systems and improves learning and knowledge organization.
CO3	Design the database using normalization techniques to reduce redundancy	SDG8	Decent Work & Economic Growth	Normalization reduces redundancy and improves efficiency, leading to **cost-effective and high-performance systems**, supporting productivity and growth.
CO4	Apply locking techniques for concurrent transactions and recover the database from failures	SDG9	Industry, Innovation and Infrastructure	Locking and recovery techniques ensure **data reliability and system availability**, which are critical for industrial and real-time applications.

ARTIFICIAL INTELLIGENCE

Class: B. Tech. IV – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI402**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply AI problem solving techniques for various engineering problems

CO2 : apply search strategies including local search, CSP's and adversarial search to solve complex AI problems in deterministic, nondeterministic and partially observable environments

CO3 : develop effective decision-making AI systems using first order logic and planning concepts

CO4 : apply probabilistic reasoning for decision-making and demonstrate hardware and software concepts used in robotics

UNIT-I	9 Hrs

Introduction: Introduction to AI, The foundations and history of AI

Intelligent Agents: Agents and environments, Nature of environments, Structure of agents

Problem Solving: Problem-solving agents, Example problems searching for solutions, Uninformed and informed search strategies, Heuristic functions

UNIT-II	9 Hrs

Search in Complex Environments: Local search and optimization problems, Local search in continuous space, Searching in nondeterministic actions, Search in partially observable environments

Constraint Satisfaction Problems (CSP): Constraint propagation, Backtracking search for CSPs

Adversarial Search: Game theory, Optimal decision in games, Mini-max search procedure, Heuristic alpha-beta tree search

UNIT-III	9 Hrs

Logical Agents: Knowledge based agents, Wumpus world, Propositional logic

First Order Logic (FOL): Syntax and semantics, Using FOL, Knowledge engineering, Inference in FOL, Forward chaining, Backward chaining, Resolution

Automated Planning: Definition, Algorithms for planning state space search, Planning graphs, Classical planning approaches, Heuristics for planning, Hierarchical planning, Planning in non-deterministic domains, Time schedule and resources

UNIT-IV	9 Hrs
Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Bayes' Rule **Probabilistic Reasoning:**Representing knowledge in an uncertain domain, The semantics of bayesian networks, Efficient representation of conditional distributions, Exact and approximate inference in bayesian networks, Probabilistic reasoning over time, Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman filters, Dynamic bayesian networks **Robotics:**Robotic hardware, Robotic perception, Planning and control, Application domains **Case study:**IBM Watson Health: Revolutionizing Patient Care with AI	

Text book(s):

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., New Delhi: Prentice Hall Series in AI, 2022. *(Chapters 1 to 9, 11, 12, 13, 14, 26)*

Reference Book(S):

1. Noah Gift, Alfredo Deza, *Practical MLOps,* First Edition, O'Reilly Media, 2021.
2. Hannes Hapke, Catherine Nelson, *Building Machine Learning Pipelines*, First Edition, O'Reilly Media, 2020.
3. Chris Fregly, Antje Barth, *Data Science on AWS*, First Edition, O'Reilly Media, 2021.
4. Yaron Haviv, Noah Gift, *Implementing MLOps in the Enterprise*, First Edition, O'Reilly Media, 2023.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_cs07/preview, NPTEL Video Lecture on Artificial Intelligence: Knowledge Representation And Reasoning by Prof. Deepak Khemani, IIT Madras.

Course Articulation Matrix (CAM):				U24AI402: ARTIFIICIAL INTELLIGENCE										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI402.1	2	2	2	2	1	1	1	1	1	-	2	2	1
CO2	U24AI402.2	2	3	3	2	1	1	1	1	1	-	2	3	1
CO3	U24AI402.3	2	3	3	2	1	1	1	1	1	-	2	3	1
CO4	U24AI402.4	2	2	2	3	1	1	1	1	1	-	2	3	1
U24AI402		2	2.5	2.5	2.25	1	1	1	1	1		2	2.75	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply AI problem solving techniques for various engineering problems.	**SDG 9**	Industry, Innovation and Infrastructure	AI problem-solvingtechniques foster innovation and support the development of intelligent engineering solutions and digital infrastructure.
CO2	Apply search strategies including local search, CSPs and adversarial search to solve complex AI problems in deterministic, nondeterministic and partially observable environments.	**SDG 8**	Decent Work and Economic Growth	AI-based optimization and search techniques enhance automation, productivity, and innovation-driven economic growth.
CO3	Develop effective decision-making AI systems using first order logic and planning concepts.	**SDG 11**	Sustainable Cities and Communities	AI planning and decision-making systems support smart city applications, resource management, and sustainable urban development.
CO4	Apply probabilistic reasoning for decision-making and demonstrate hardware and software concepts used in robotics.	**SDG 13**	Climate Action	Probabilistic AI models, environmental monitoring systems, and intelligent robotics can be used for climate analysis, sustainability assessment, and environmental decision-making.

SOFTWARE ENGINEERING

Class: B. Tech. IV – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI403**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : design the appropriate software model for a given real time application

CO2 : develop architectural designs and class based components for given software

CO3 : apply an appropriate testing method for a given software

CO4 : apply metrics to assess the quality of software and analyze the risk management in project scheduling

UNIT-I	**9 Hrs**

Software Engineering Concepts: The changing nature of software, Software application domains, Legacy software, Software myths, Software engineering layered technology, A process framework, The capability maturity model integration (CMMI), Agile software Process Models -Prescriptive process models, RAD model, Specialized process models, Unified process model, Personal and team process models

Agile Development: Agility and the cost of change, Agile process, Extreme programming, Other agile process models

Software Engineering Practices: Communication principles, Planning principles, Modeling principles, Construction principles, Deployment principles

UNIT-II	**9 Hrs**

Requirements Engineering Tasks: Requirements analysis and modelling strategies, User requirement, System requirement, Software requirements document.

Requirements modelling: Case studies on scenario-based methods (Hospital management system and Airline reservation system)

Design Engineering: Design within the context of software engineering, Design process, Design concepts, The design model

Architectural Design: Software architecture, Architectural genres, Architectural styles, Architectural design, Assessing alternative architectural designs, Designing class based components, Conducting component level design, Design for WebApps, Designing traditional components

UNIT-III	**9 Hrs**

User Interface Design: The golden rules, User interface analysis and design, Interface analysis, Interface design steps, WebApp and mobile interface design

Testing Strategies: Software testing fundamentals, Test strategies for conventional software, Test strategies for object-oriented software, Validation testing, System testing, The art of Debugging, White box testing, Basis path testing, Control structure testing, Black box testing

Testing Web Applications: Testing concepts for webapps, The testing process, Content testing, User interface testing, Component-level testing, Navigation testing, Configuration testing, Security testing, Performance testing, Case studies on testing methods (Banking App – Security Testing, Online Education Platform – Load Testing and E-Commerce Website – Functional Testing)

UNIT-IV	9 Hrs

Product Metrics: Measures, Metrics and indicators, Metrics for the requirements model,

Metrics for the design model, Metrics for source code, Metrics for testing, Metrics for maintenance

Process and Project Metrics: Metrics in the process and project domains, Software measurement, Metrics for software quality, Integrating metrics within the software process, The W5HH principle project scheduling: Project scheduling, Scheduling for WebApps projects, Earned value analysis

Risk Management: Reactive versus Proactive risk strategies, Software risks, Risk identification, Risk projection, Risk refinement, RMMM plan

Textbook(s):

1. Roger S.Pressman and Bruce R.Maxim, *Software Engineering: A Practitioner's Approach*, McGraw-Hill Education, 8th edition, 2019, New York (Chapters 1 to 5, 12, 13, 15, 22, 25, 30, 34 and 35).

Reference Book(s):

1. Ian Sommerville, *Software Engineering*, Pearson, 10th edition, 2016, Boston.
2. Deepak Jain, *Software Engineering: Principles and Practices*, Oxford, 3rd edition, 2008, New Delhi.
3. Pankaj Jalote, *Software Engineering: A Precise Approach*, McGraw Hill Education, 1st edition, 2010, New Delhi.

Web and Video link(s):

https://archive.nptel.ac.in/courses/106/105/106105182, *NPTEL Video Lecture on Use case modelling by Prof. Rajib Mall, IIT Kharagpur.*

Course Articulation Matrix (CAM):				U24AI403: SOFTWARE ENGINEERING									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**U24AI403.1**	1	1	1	1	-	-	-	1	1	1	2	2	1
CO2	**U24AI403.2**	1	1	1	1	-	-	-	1	1	1	2	1	1
CO3	**U24AI403.3**	2	2	1	1	-	1	1	1	1	1	2	2	1
CO4	**U24AI403.4**	2	2	2	1	-	1	1	1	1	1	2	2	1
U24AI403		1.5	1.5	1.25	1	-	1	1	1	1	1	2	1.75	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix

CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	design the appropriate software model for a given real time application	SDG 9	Industry, Innovation and Infrastructure	Promotes the design and development of robust, maintainable, and scalable software architectures, fostering innovation and strengthening digital infrastructure.
CO2	develop architectural designs and class based components for given software	SDG 8	Decent Work and Economic Growth	Builds professional software design and development skills, preparing students for careers in the software industry and contributing to innovation, productivity, and economic growth.
CO3	apply an appropriate testing method for a given software	SDG 4	Quality Education	Develops students' knowledge and practical skills in software quality assurance, testing, and validation, supporting quality education and lifelong learning.
CO4	apply metrics to assess the quality of software and analyze the risk management in project scheduling	SDG 11	Sustainable Cities and Communities	Promotes the development of reliable, high-quality, and risk-managed software systems that support sustainable urban infrastructure and public services.

COMPUTER NETWORKS

Class: B. Tech. IV – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI404**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: network reference models, physical layer components, data link and medium access control protocols

CO2: network Layer design, Various routing and Congestion control algorithms

CO3: internetworking, IPv5: addressing, routing and IPV6 & Transport Layer services, connection, error and flow control management and error handling

CO4: TCP and UDP services, error, congestion management; Application Layer: DNS, Mail,

WWW, Streaming Audio and Video, Server Farms and Web Proxies, Content Delivery

Networks, P2P Networks

UNIT-I	9 Hrs

Introduction to Computer Networks: Introduction,Network Hardware, Network Software, OSI Reference Model, TCP/IP Reference Model.

Physical Layer: Guided Transmission Media, Wireless Transmission, Circuit Switching, Packet Switching.

Data Link Layer Switching: Repeaters, Hubs, Bridges, Switches, Virtual LANs (VLANs).

UNIT-II	9 Hrs

Data Link Layer: Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols.

MAC Sublayer: Channel Allocation Problem, ALOHA, Carrier Sense Multiple Access (CSMA), Collision-Free Protocols, IEEE Standard 802: Token Bus, Token Ring.

Ethernet and LAN Technologies: Switched Ethernet, Fast Ethernet, Gigabit Ethernet

UNIT-III	9 Hrs

Network Layer: Network Layer Design Issues.

Routing Algorithms: Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing.

Congestion Control Algorithms: Approaches to Congestion Control, Traffic Aware Routing, Admission Control, Traffic Throttling, Load Shedding.

Internetworking and Internet Protocols: How Networks Differ, How Networks Can Be Connected, Tunneling, Internetwork Routing, IP Version 4 Protocol, IP Addresses, IP Version 6 Protocol, Internet Control Protocols, OSPF – Interior Gateway Routing Protocol, BGP – Exterior Gateway Routing Protocol, Routers, Gateways.

UNIT-IV	9 Hrs

Transport Layer: Transport Services, Elements of Transport Protocols – Connection Establishment and Release, Error Control and Flow Control.

Internet Transport Protocols: UDP – Remote Procedure Call (RPC), Real Time Transport Protocol (RTP). TCP – Service Model, Protocol, Sliding Window, Timer Management and Congestion Control.

Application Layer: Domain Name System (DNS), Electronic Mail, World Wide Web (WWW).

Content Delivery Systems: Server Farms and Web Proxies, Streaming Live Media.

Textbook(s):

1. **Andrew S. Tanenbaum and David J. Wetherall**, *Computer Networks*, 5th Edition, Pearson Education, 2011.
2. **James F. Kurose and Keith W. Ross**, *Computer Networking: A Top-Down Approach*, 8th Edition, Pearson Education.

Reference Book(s):

1. William Stallings, *Data and Computer Communications*, 10th ed., London: Pearson Education, 2014
2. Behrouz Forouzan, *Data Communication and Networking*, 5th ed., New York: Tata McGraw Hill, 2012.
3. Larry Peterson, Bruce S Davie, *Computer Networks*, 5th ed., New York: Elsevier Inc., 2011

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_cs15/preview*NPTEL Video Lecture onComputer Networks and Internet Protocol, By Prof. Soumya Kanti Ghosh, Prof. SandipChakraborty, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24AI404: COMPUTER NETWORKS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI404.1	2	2	2	1	-	-	1	1	1	-	1	1	1
CO2	U24AI404.2	2	2	2	1	-	-	1	1	1	-	1	1	1
CO3	U24AI404.3	2	2	2	1	-	-	1	1	1	-	1	2	1
CO4	U24AI404.4	2	2	2	1	-	-	1	1	1	-	1	2	1
U24AI404		2	2	2	1	-	-	1	1	1	-	1	1.5	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement (The student should be able to...)	Relevant SDG	SDG Description	Mapping Justification
CO1	Analyze the functionalities of OSI and TCP/IP models, transmission media, switching techniques, Ethernet technologies, and networking devices.	SDG 4	Quality Education	Develops fundamental knowledge and technical competencies in computer networking.
CO2	Analyze data link layer protocols, MAC mechanisms, error control techniques, and LAN communication technologies.	SDG 9	Industry, Innovation and Infrastructure	Supports the design and operation of reliable communication infrastructures and networking systems.
CO3	Explain internetworking concepts, IPv4/IPv6 protocols, routing algorithms, congestion control, and transport layer fundamentals.	SDG 9	Industry, Innovation and Infrastructure	Contributes to the development of scalable, efficient, and innovative Internetandcommunication infrastructures.
CO4	Compare TCP and UDP protocols and evaluate application layer services such as DNS, Email, WWW, and content delivery systems.	SDG 8	Decent Work and Economic Growth	Enhances digital communication services that improve productivity, connectivity, and economic activities.

PYTHON PROGRAMMING

Class: B.Tech. IV -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI405**	**Credits:**	**4**
Hours/Week (L-T-P-O-E):	**2-1-2-5-10**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply python syntax, control structures, operators, and functions to develop structured programs to solve basic problems

CO2: develop modular python programs using strings, regular expressions, built-in collections, and namespaces for efficient data handling

CO3: develop python applications using object-oriented principles, exception handling, file operations, operator overloading, threads and database connectivity

CO4: analyze and visualize data using python libraries such as NumPy, pandas, and Matplotlib for data science applications

THEORY COMPONENT

UNIT-I	9 Hrs

Introduction: Features of python, The future of python, Writing and executing python programs

Python Preliminaries: Literal constants, Variables and identifiers, Data types, Input operation, Comments, Reserved words, Indentation, Operators, Expressions in python, Type conversion

Decision Control Statements: Selection/Conditional branching statements, Loop structures/ iterative statements, Nested loop, the continue statement, the pass statement, the else statement used with loops

Functions: Function definition, Function call, Variable scope and lifetime, the return statement, Advances in defining in functions, Lambda functions, Recursive functions

UNIT-II	9 Hrs

Modules and Name Spaces: The from…import statement, Naming module, the dir() function, Packages in python, Standard library modules, globals(), locals(), and reload(), Function redefinition

Python Strings: String operations, String formatting operator, Built-in string methods and functions, slice operation, ord() and Chr() functions, in and not in operators, Comparing strings, Regular expressions and meta characters

Data Structures: Lists, Tuple, Sets, Dictionaries

UNIT-III	9 Hrs

Python Object Oriented Programming: Classes and objects, Class method and self-argument, The __init__() method, Class variables and object variables, The __del__() method, Public and private data members, Private methods, Calling a class method from another class method, Built-in class attributes, Class methods, Static methods, Inheritance and polymorphism

Operator overloading: Advantage of operator overloading, Implementing operator overloading

Error and Exception handling: Introduction to errors and exceptions, Handling exceptions, Multiple except blocks, Built-in and user-defined exceptions, The finally block

File Handling: Opening and closing files, Reading and writing files, File positions, Renaming and deleting files, Directory methods

Threads: An introduction to python threading, Multithreading in python
Database Connectivity: SQLite, Creating a database table, Insert and retrieve data from database

UNIT-IV	9 Hrs

NumPy: The basics of NumPy arrays, Array indexing, Array slicing, Reshaping of array, Concatenation and splitting arrays, Introducing UFuncs

Data Manipulation with Pandas: Installing and using pandas, Introducing Pandas objects, data indexing and selection, Handling missing data, Combining datasets, Merge and join, Aggregation and grouping

Visualization with Matplotlib: Importing matplotlib, Saving figures to files, Simple line plots, Simple scatter plots, Histograms, Binnings, and density

Text Book(s):

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed., New Delhi: Oxford University Press, 2017. *(Chapter 1 to 7)*
2. Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, 1st ed., California: O'Reilly Media Inc., 2016. (*Chapter 2 to 4*)

Reference Book(s):

1. Dr.Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, 1st ed., USA: open book, 2016
2. David Beazley, *Python Cookbook*, 3rd ed., California: O'Reilly Media, Inc., 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using (But Should)*, 2nd ed., California: O'Reilly Media Inc., 2016
4. Magnus Lie Hetland, *Beginning: from Novice to Professional*, 3rd ed., New York City: A press, 2005

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc23_cs99/ *NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.*
2. https://onlinecourses.nptel.ac.in/noc25_cs17 *NPTEL Video Lecture on Data Analytics with Python By Prof. A Ramesh, IIT Roorkee.*
3. https://onlinecourses.nptel.ac.in/noc25_cs69/ *NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar*

Course Articulation Matrix (CAM):				**U24AI405: PYTHON PROGRAMMING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI405.1**	1	2	2	2	2	1	-	1	1	1	1	2	2
CO2	**U24AI405.2**	2	2	2	2	2	1	-	1	1	1	1	2	2
CO3	**U24AI405.3**	2	2	2	2	3	1	-	1	1	1	1	2	2
CO4	**U24AI405.4**	2	2	2	2	3	1	-	1	1	1	1	2	2
U24AI405		1.75	2	2	2	2.5	1	-	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO StatementThe student should be able to…**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply python syntax, control structures, operators, and functions to develop structured programs to solve basic problems	**SDG 4**	Ensure inclusive and equitable quality educationand promote lifelong learning opportunities for all.	Equips students with foundational programming logic and computational thinking, directly contributing to Target 4.4 by increasing technical and vocational skills for employment.
CO2	Develop modular Python programs using functions, modules, packages, and string manipulation techniques.	SDG 4	Quality Education	Modular programming concepts enhance problem-solving abilities andsoftware development skills, contributing to quality education and technical competency.
CO3	develop python applications using object-oriented principles, exception handling, file operations, operator overloading,threads and database connectivity	**SDG 9**	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	Applies enterprise-grade software principles (OOPs, databases, multithreading) to build scalable IT applications.
CO4	analyze and visualize data using python libraries such as NumPy, pandas, and Matplotlib for data science applications	**SDG 9**	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	Employs diagnostic libraries (NumPy, pandas, Matplotlib) to evaluate real-world infrastructure and foster innovation via predictive modeling

QUANTITATIVE APTITUDE AND LOGICAL REASONING

Class: B.Tech. IV-Semester		**Branch:** Common to all Branches	
Course Code:	**U24VA406A**	**Credits:**	**2**
Hours/Week (L-T-P-O-E):	**2-0-0-2-4**	**CIE**	**60 %**
Total Number of Teaching Hours:	**48 Hrs**	**ESE**	**40 %**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: quantitative aptitude & problem-solving skills

LO2: computation of abstract quantitative information

LO3: application of basic mathematics skills & critical thinking to draw conclusions

LO4: evaluation of validity & possible biases in arguments presented in authentic contexts

UNIT-I	12 Hrs
Quantitative Aptitude-I: Number system, Averages, Percentages, Ratios & proportions, Time, Speed & distance, Time and work	
UNIT-II	**12 Hrs**
Quantitative Aptitude-II: Simple interest, Compound interest, Profit & loss, Ages, Permutations & Combinations, Probability	
UNIT-III	**12 Hrs**
Logical Reasoning-I: Series completion, Analogy, Coding and decoding, Blood relations, Number, Ranking & Time sequence test, Linear & Circular arrangements	
UNIT-IV	**12 Hrs**
Logical Reasoning-II: Data sufficiency, Logical Venn diagram, Syllogisms, Statement & Arguments, Statement & Assumptions, Direction sense test	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to…

CO1: apply arithmetic concepts such as averages, percentages, ratios, and time-based calculations to solve real-life quantitative problems

CO2: analyze and solve problems involving financial, arithmetic and probability using structured quantitative methods

CO3: identify patterns and apply deductive reasoning to solve series, coding-decoding, and arrangement-based logical problems

CO4: evaluate logical statements, assess validity, and draw conclusions using tools like syllogisms, Venn diagrams, and argument analysis

Note: Students should go through the QALR course supplementary material made available on online learning platform

- *Contents covered in class shall be practiced through the material available on the online learning platform. At home practice problems and practice tests shall be made available on the online learning platform*
- *Tutorial classes shall be conducted on the online learning platform and hence students shall attend the tutorial classes with laptop/tab*
- *All assessments shall be conducted through online learning platform*

Text Book(s):

1. R S Agarwal, *Quantitative Aptitude for Competitive Examinations*, 3rd ed. New Delhi: S. Chand Publications, 2019. *(Chapters 1,6,7,8,10,11,12,15,17,21,22,30,31 - for Unit I & II)*
2. R S Agarwal, *A Modern Approach to Verbal and Non-Verbal Reasoning*, 3rd ed. New Delhi: S. Chand Publications, 2019. *(Chapters Section I: 1,3,4,5,6,8,16, Section II: 2,3 - for Unit III & IV)*

Reference Book(s):

1. Dinesh Khattar, *Quantitative Aptitude for Competitive Examinations*, 1st ed., New Delhi: Pearson India, 2019.
2. Nishit K Sinha, *Reasoning for Competitive Examinations*, 1st ed., New Delhi: Pearson India, 2019.
3. R.N.Thakur , *General Intelligence and Reasoning*, 1st ed., New Delhi: McGraw Hill Education, 2017.

Course Articulation Matrix (CAM):		**U24VA406A QUANTITATIVE APTITUDE & LOGICAL REASONING**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24VA406A.1**	1	2	-	1	-	-	-	-	-	-	1	1	-
CO2	**U24VA406A.2**	1	2	-	1	-	-	-	-	-	-	1	1	-
CO3	**U24VA406A.3**	-	1	-	2	-	2	-	-	-	-	1	1	-
CO4	**U24VA406A.4**	-	1	-	2	-	2	-	-	-	-	1	1	-
U24VA406A		**1**	**1.5**	**-**	**1.5**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**-**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Programming Skill Development Lab-3

Class: B.Tech. IV -Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24SE407**	**Credits:**	**1**
Hours/Week (L-T-P-O-E):	**0-0-2-2-4**	**CIE :**	**100%**
Total Number of Lab Hours:	**36 Hrs**	**ESE :**	**-**

Course Learning Objectives (LOs):

This course will develop students' knowledge in / on…

LO1: basic java implementation that demonstrates the use of data types, type casting, arrays, and class concepts

LO2: classes, methods and strings

LO3: types of inheritance, dynamic method dispatch, interface and packages

LO4: streams (I/O), exception handling and mutli-threading

LABORATORY COMPONENT

S. No.	List of Experiments
1.	a) Develop a Java program using a class named Arithmetic. Read two numbers from the command line arguments and perform all basic arithmetic operations: addition, subtraction, multiplication, division, and modulus. Use separate methods for each operation: add() for addition, sub() for subtraction, mul() for multiplication, div() for division, mod() for modulus. b) Develop a Java program using a class named Matrix to perform the multiplication of two matrices. The matrix values should be read from the keyboard. The program should: i. Read two matrices (of user-defined size) from the keyboard. ii. In the Matrix class, implement a method mul() to multiply two matrices. iii. Before performing multiplication, check whether the multiplication condition is satisfied (i.e., the number of columns in the first matrix must be equal to the number of rows in the second matrix). iv. If the condition is satisfied, compute and display the product of the two matrices. v. Otherwise, display a message indicating that matrix multiplication is not possible with the given matrix dimensions. c) Develop a Java program to demonstrate wrapper class by read five numbers using command line arguments and print the prime numbers from the given numbers.
2.	a) Develop a Java program to recursively linearly search an element in an array. b) Develop a Java program to interchange elements of first and last in a matrix across rows and interchange elements of first and last in a matrix across columns. **Note:** Read the first matrix from user input for the second program take the first program output as input. c) Develop a Java program to implement a seating reservation system using a 2D array in Java. **Hint:** A cinema hall has a fixed number of rows and columns of seats. A 5x5 array represents the seating arrangement (1 for booked, 0 for available). Users can select seats, and the program should update availability.

3.	a) Develop a Java program to determine whether two strings are anagram or not. b) Develop a Java program to simulate an ATM Application. The application should include the following functionalities: like 1) Withdraw 2) Deposit 3) Check balance 4) Exit. The program should allow the user to choose an option from a menu and perform the corresponding operation. Proper validations (like checking for sufficient balance during withdrawal) should be implemented
4.	a) Develop a Java program to find all the permutations of a string. Hint: Permutations of "abc": abc acb bac bca cab cba. b) Develop a Java program to find the largest and smallest word in a string based on the length of the word. c) Develop a Java program to find the duplicate words in a string.
5.	a) Develop a Java function to split the string using a string tokenizer using following scenario. A CSV file contains the following line: "John,Doe,35,New York, Software Engineer" You need to extract and print: First Name Last Name Age City Job Title. b) Develop a Java program based on following scenario. A user types "I love Java" but wants to insert "programming" between "love" and "Java", making it: "I love programming Java".
6.	a) Develop a Java program that design a class Employee with multiple ways to initialize it. One constructor takes an employee ID and name, while another takes an employee ID, name, and salary. Based on above data implement constructor overloading in Java. b) Develop a Java program by writing an overridden getNumberOfTeamMembers method that prints the same statement as the super class getNumberOfTeamMembers method,

		except that it replaces with (the number of players on a Soccer team). **Output Format** When executed, your completed code should print the following: **Generic Sports** Each team has n players in Generic Sports **Soccer Class** Each team has 11 players in Soccer Class
7.	a)	Develop a Java program that a bank has different types of accounts. A Savings Account is a specialized type of **Bank Account** that has additional features like interest calculation. We implement this scenario using single inheritance where SavingsAccount inherits from Bank Account. Bank Account (Parent Class): **Hint:** Holds account details and common operations (deposit, withdraw, display Account Details). Savings Account (Child Class, Single Inheritance): Inherits Bank Account properties and methods. Adds a new method addInterest() to calculate interest. Main Class (Bank Application): Creates a Savings Account object, performs operations, and displays details
	b)	Develop a Java program that design a payment gateway system that supports multiple payment methods such as Credit Card and UPI. Define an interface Payment with a method processPayment(double amount). Implement two classes: **CreditCardPayment** that implements processPayment() and displays "Processing credit card payment of $" + amount. **UPIPayment** that implements processPayment() and displays "Processing UPI payment of $" + amount. In the main() method, accept a payment method and amount from the user and process the payment accordingly.
8.	a)	Develop a java program to demonstrate on a hierarchy of classes representing different types of animals: Animal, Dog, and Cat. Animal has a method called makeSound(). Dog and Cat override this method to provide their specific sounds.
	b)	Develop a java program to demonstrate the scenario which involves implementing a Notification System where different services (Email, SMS, Push) send messages using a common interface, Notifier, with the method void send(String message), and a method that accepts any Notifier to send a notification.
	c)	Develop a java program to demonstrate the scenario demonstrates the Strategy Pattern using interfaces by defining a SortStrategy interface with a void sort(int[] arr) method, and implementing different sorting algorithms like BubbleSort, QuickSort, and MergeSort, allowing the user to choose and apply a sorting strategy at runtime.

9.	a) Develop a java program based on the following scenario You are working on an e-commerce website where an order processing system runs in the background while users continue shopping. How will you ensure the background process does not affect user experience? **Hint:** Use ScheduledExecutorService for this task. b) Develop a java program to demonstrate the scenario involves building a modularized Library Management System in Java by organizing the application into packages—library.books, library.users, and library.transactions—each containing relevant classes like Book, User, and IssueTransaction, with a Main class in the library.main package to manage the overall system.
10.	a) Develop a java program based on the scenario 'Payment Gateway Exception Handling' that you are integrating a payment gateway for an e-commerce website. Sometimes, payments fail due to network issues or incorrect card details. How will you handle these exceptions gracefully? Write code for failed transactions. Write code for the users are notified properly. b) Develop a java program demonstrate on 'you are tasked with creating a program that processes two numbers input by the user prompt the user has to enter two numbers: numerator and denominator and validate the inputs like if the user enters non-numeric values, the program should handle it gracefully and Perform the division and display the result. Handle the following exceptions: InputMismatchException if non-integer values are entered. ArithmeticException if the denominator is zero. Any other Exception that might occur unexpectedly.
11.	a) Develop a java program based on the following scenario Reading from a File You are developing a program that reads a list of students' names from a file called students.txt and displays them on the console. How would you handle file reading exceptions? What happens if the file does not exist? b) Develop a java program based on the following scenario Scenario: Student Management System you can create a package called student containing a Student class, and another package main containing the Main class to use the Student class.
12.	a) Develop a java program based on the following **Scenario**: Implementing a Producer-Consumer System

Problem Statement: You are tasked with implementing a producer-consumer system where multiple producer threads generate data and place it into a shared buffer, and multiple consumer threads process the data from the buffer. The system should ensure that the buffer has a fixed size and can hold a limited number of items,producers should wait if the buffer is full, consumers should wait if the buffer is empty and the system should handle synchronization to prevent race conditions.

b) Develop a java program based on the following **scenario**: Managing a Shared Resource
Problem Statement: You are tasked with implementing a system where multiple threads represent users accessing a shared printer. The printer can only handle one user at a time, and each user requires a random amount of time to print a document. Your goal is to ensure that only one user can access the printer at any given time, users should wait if the printer is currently in use and once a user finishes printing, another waiting user should be allowed to use the printer.

Text Book(s):

1. Herbert Schildt, *Java The Complete Reference*, 13th ed., New Delhi: McGraw-Hill Education, 2019.
2. Harvey Deitel, Paul J. Deitel, *Java How to Program,* 11th ed., New Delhi: Pearson Publications, 2018.
3. KathySierra, BertBates, *Head First Java*, 2nd ed., Boston: O'Reilly Publications, 2005.

Reference Book(s):

1. Uttam K. Roy, *Advanced JAVA Programming*, 1st ed., England: Oxford Publications,2013
2. Balaguruswamy, *Programming with Java: A Primer*, 7th ed., New Delhi: McGraw-Hill Education India Pvt. Ltd., 2019.
3. TanweerAlam, *Internet and Java Programming*, 1st ed., New Delhi: Khanna Publishing House, 2010.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to …

CO1: develop and test various java programming paradigms and java fundamental programs
CO2: develop and test java programs using classes, constructors and various string concepts
CO3: analyze how reusability concepts such as inheritance, interfaces, and packages are utilized in building efficient, maintainable java programs
CO4: develop and test java programs using streams (Input/output), exception handling and multithreading concepts

Course Articulation Matrix (CAM):				**U24SE407 : Programming Skill Development Lab-3**									
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24SE407.1**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO2	**U24SE407.2**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO3	**U24SE407.3**	2	2	1	1	1	-	1	1	1	1	1	2	2
CO4	**U24SE407.4**	2	2	1	1	1	-	1	1	1	1	1	2	2
U24SE407		**2**	**2**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

DATABASE MANAGEMENT SYSTEMS LABORATORY

Class: B. Tech. IV – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI408**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on psychomotor skills acquired from laboratory component)

CO1 : implement and test SQL queries using DDL/DML/TCL/DCL commands to create and manipulate data in database by enforcing constraints

CO2 : implement and test database objects, tables, views, indexes, stored procedures, functions, triggers and constraints using SQL queries

CO3 : implement and test block structured programming with cursors to enable traversal over the records of the database redundancy and maintain the performance of database.

CO4 : implement and test pre-compiled stored programs, run-time errors checking, database objects collection in PL/SQL high-level security using triggers

List of Experiments

Experiment-I

1. Queries on DDL and DML statements.

Experiment-II

2. Queries on TCL and DCL commands.

Experiment-III

3. Queries on column level and table level constraints.

Experiment-IV

4. Queries using built-in functions of NUMBER, CHARACTER, DATE Data types.

Experiment-V

5. Queries on single row functions and operators and aggregate functions.

Experiment-VI

6. Queries on joins and nested queries.

Experiment-VII

7. Write SQL statements to create simple, composite indexes, user-defined data types, views, sequences.

Experiment-VIII

8. Write sample PL/SQL programs using conditional and iterative statements.

Experiment-IX

9. Write PL/SQL programs using cursors and parameterized cursors.

Experiment-X

10. Write PL/SQL programs to handle exceptions.

Experiment-XI

11. Write PL/SQL programs using stored procedures and functions.

Experiment-XII

12. Write PL/SQL programs for creating triggers

<u>Laboratory Manual</u> (for laboratory component):

1. *Database Management Systems Laboratory Manual and Record Book,* Department of CSE(AI&ML), KITSW

Course Articulation Matrix (CAM):		**U24AI408 : DATABASE MANAGEMENT SYSTEMS LABORATORY**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI408.1**	3	2	1	-	3	-	-	-	-	-	-	1	3
CO2	**U24AI408.2**	3	3	3	2	3	-	-	-	-	-	-	1	3
CO3	**U24AI408.3**	3	3	2	2	2	-	1	-	-	-	-	2	3
CO4	**U24AI408.4**	3	2	3	2	3	-	-	2	-	-	-	2	3
U24AI408		3	2.5	2.25	2	2.75	-	1	2	-	-	-	1.5	3
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Implement and test SQL queries using DDL / DML / TCL/ DCL commands to create and manipulate data in database by enforcing constraints	SDG4	Quality Education	builds fundamental database skills through SQL, helping students gain strong technical knowledge and practical learning experience, which directly contributes to quality education.
CO2	Implement and test database objects, tables, views, indexes, stored procedures, functions, triggers and constraints using SQL queries.	SDG9	Industry, Innovation and Infrastructure	focuses on designing and implementing advanced database systems, which are essential for building innovative and scalable software infrastructure in real-world applications.
CO3	Implement and test block structured programming with cursors to enable traversal over the records of the database, reduce redundancy and	SDG9	Industry, Innovation and Infrastructure	emphasizes performance optimization and efficient data handling, which are critical for developing high-performance and reliable database systems, aligning with innovation and

	maintain performance.			infrastructure development.
CO4	Implement and test pre-compiled stored programs, run-time error checking, database object collections in PL/SQL and ensure high-level security using triggers.	SDG11	Sustainable Cities and Communities	focuses on database security, automation, and reliability. Secure data systems are essential for smart city applications, governance systems, and sustainable digital infrastructure.

PYTHON PROGRAMMING LABORATORY

Class: B. Tech. IV – Semester		**Branch:** CSE (AI & ML)	
Course Code:	U24AI409	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: develop and test python programs by applying operators, control structures, and user-defined functions to address basic computational problems

CO2: demonstrate the use of namespaces, packages, string handling functions, regular expressions, and built-in data structures to develop optimized python programs

CO3: develop and test object-oriented programs by creating custom classes, manipulating objects, handling files, threads and executing database operations in python

CO4: design visual representations of data using Matplotlib and experiment with Numpy and pandas libraries to analyze datasets programmatically

Experiment-1

1. Installation of Python and verifying PATH environment variable
2. Running instructions in Interactive interpreter and a python script
   a. Executing instructions in Python Interactive Interpreter
   b. Running python scripts in Command Prompt
   c. Running python scripts in IDLE
3. Write a program to demonstrate importance of indentations. Purposefully raise indentation error and correct it
4. Write a program to take input text as command line argument and display it on screen

Experiment-2

1. Write a program that takes 2 numbers as command line arguments and print its sum
2. Write a program to check whether the given number is even or odd
3. Write a program to calculate GCD of 2 numbers
4. Write a program to find Exponentiation (Power) of a number
5. Write a program to find given year is leap year or not
6. Write a program to develop a simple calculator

Experiment-3

1. Write a program to find the Factorial of a given number
2. Write a program to evaluate the Fibonacci series for a given number ‗n'
3. Write a program to find the Armstrong for a given number
4. Write a program to find sum of N numbers
5. Write a program to take a number as input, and print countdown from that number to zero (use while loop)
6. Write a program to find circulating ‗n' values

Experiment-4

1. Write a program to implement a module using import statement (Use python source file as a Module and implement import statement another python source files)

2. Write a program to implement from, import statement 3. Write a program to implement dir() function 4. Write a program to demonstrate packages in python
Experiment-5
1. Write a python program on strings for the following a. To display substring in a string b. To update an existing string c. To implement string concatenation d. To demonstrate string formatting operator
Experiment-6
1. Write a program to demonstrate use of slicing in strings 2. Write a program to compare two strings 3. Write a program which prints the reverse of a given input string. (use a function with name Reverse string and call this function for performing the operation) 4. Write a program to demonstrate built-in string methods 5. Write a program to demonstrate list and related functions
Experiment-7
1. Write a program to demonstrate tuple, set and related functions 2. Write a program to demonstrate dictionaries 3. Write a program to demonstrate RegEx functions 4. Write a program to demonstrate regular expressions using Meta characters
Experiment-8
1. Write python program for the following a. To demonstrate classes and objects b. To demonstrate class method and static method c. To demonstrate inheritance 2. Write python program on file operations for the following a. To open and read data from a file b. To write data into a file c. To compute number of characters, words, lines in a file
Experiment-9
1. Write python programs to implement database connectivity a. Install and verify SQLite Connector for Python b. To connect check SQLite Database connectivity c. To retrieve and display data from a table d. To insert data into a table e. To delete rows in a table
Experiment-10
1. Install and setup NumPy environment 2. Write a program to demonstrate NumPy array 3. Write a program to demonstrate Slice operation 4. Write a program to demonstrate Reshaping of an array

Experiment-11
1. Install and setup panda's environment 2. Write a python pandas program to create a series from and array 3. Write a python pandas program to demonstrate indexing and selecting data
Experiment-12
1. Install and setup matplotlib 2. Write a program to draw a simple line plot 3. Write a program to draw a histogram plot 4. Customize plots and experiment with different maps plots
Textbook(s): 1. Reema Thareja, *Python Programming Using Problem Solving Approach*, 1st edition, New Delhi: Oxford University Press, 2017. (Chapters 1–9) 2. Jake VanderPlas, Python Data Science Handbook- Essential Tools for Working with Data, 1st edition, California: O'Reilly Media Inc., 2016. (Chapter 2 to 4)
Reference Book(S): 1. Dr. Charles R. Severance, *Python for Everybody: Exploring Data Using Python,* 1st edition, USA: Open Book, 2016. 2. Allen B. Downey, *Think Python: How to Think Like a Computer Scientist*, 2nd edition, O'Reilly Media, 2016. 3. Eric Matthes, *Python Crash Course*, 3rd ed., No Starch Press, 2023. 4. David Beazley, *Python Cookbook*, 3rd ed., California: O'Reilly Media, Inc., 2013.
Web and Video link(s):
Laboratory Manual (for laboratory component): 2. *Python Programming,* Department of CSE (AI & ML), KITSW

Course Articulation Matrix (CAM):				U24AI409: PYTHON PROGRAMMING LABORATORY									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI409.1	1	2	2	2	2	1	1	1	1	1	2	2	2
CO2	U24AI409.2	2	2	2	2	2	1	1	1	1	1	2	2	2
CO3	U24AI409.3	2	2	2	2	3	1	1	1	1	1	2	2	2
CO4	U24AI409.4	2	2	2	2	3	1	1	1	1	1	2	2	2
U24AI409		1.75	2	2	2	2.5	1	1	1	1	1	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop and test Python programs by applying operators, control structures, and user-defined functions to address basic computational problems.	SDG 4	Quality Education	Builds foundational programming and problem-solving skills essential for quality technical education and lifelong learning.
CO2	demonstrate the use of namespaces, packages, string handling functions, regular expressions, and built-in data structures to develop optimized python programs	SDG 9		Enhances advanced programming competencies and promotes efficient software development practices that support innovation and digital infrastructure.
CO3	Develop and test object-oriented programs by creating custom classes, manipulating objects, handling files, threads, and executing database operations in Python.	SDG 9		Equips learners with industry-relevant software development skills required for employment, productivity, and technology-driven innovation.
CO4	Design visual representations of data using Matplotlib and experiment with NumPy and Pandas libraries to analyze datasets programmatically.	SDG 9		Develops data analysis and visualization skills that support informed decision-making, technological advancement, and collaborative data-driven solutions.

ENVIRONMENTAL STUDIES

Class:B.Tech. IV Semester		**Branch:** Common to ME, CSM, CSD, IT, CSN & CSO	
Course Code:	**U24CY411**	**Credits:**	**0**
Hours/Week(L-T-P-O-E):	**2-0-0-5-7**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24Hrs**	**ESE:**	**40%**

CourseLearningObjectives(LOs):
This course will develop students' knowledge in/on…

LO1: natural resources and their usage more equitably

LO2: ecosystem and the importance of biodiversity conservation

LO3: environmental pollution and it'scontrol measures

LO4: environmental legislation and green methodology

UNIT-I	6Hrs

The Multidisciplinary Nature of Environmental Studies: Definition, Scope and importance

Natural Resources: Forest Resources-Use and overexploitation of forests, Deforestation, Timber extraction, Mining, Dams and their effects on forests and tribal people**;** Water Resources-Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water**;** Mineral Resources-Environmental effects of extracting and using mineral resources**;** Energy Resources-Renewable and non-renewable energy sources, Use of alternate energy sources

Self Learning Topics (SLTs): *Use and over-utilization of surface and ground water(Text1: unit 2, topic: 2.2.2) world food problems(Text1: unit 2, topic 2.2.2)*

UNIT-II	6Hrs

Ecosystem and Biodiversity:

Ecosystem: Concepts of an ecosystem, Food chain, Food webs, Ecological pyramids, Energy flow in the ecosystem and ecological succession

Biodiversity and its Conservation: Introduction, Definition, Genetic, Species and ecosystem diversity, Value of biodiversity, Biodiversity in India, Hot spots of biodiversity, Man-wildlife conflicts, Endangered and endemic species of India; In-situ and Ex-situ conservation

Self Learning Topics (SLTs): *Introduction and definition of biodiversity (Text1: unit 4, topic 4.1)*

UNIT-III	6Hrs

Environmental Pollution: Global issues**-**Global climatic change, Greenhouse gases, Effects of global warming, Ozone layer depletion

International Conventions/Protocols: Earth summit, Kyoto protocol, Montreal protocol**Environmental Pollution-**Causes and effects of air, Water, Soil, Marine and noise pollution with case studies

Solid and Hazardous Waste Management: Introduction, Types, Effects of urban industrial and nuclear waste

Natural Disaster Management: Introduction to disaster, Management of disaster, Disaster management of flood, earthquake, cyclone and landslides

Role of information technology in environment and human health

Self Learning Topics (SLTs): *Role of individual in prevention of pollution (Text1: unit 5, topic 5.10)*

UNIT-IV	6Hrs

Social Issues and the Environment: Role of Individual and Society, Water conservation, Rain water harvesting

Environmental Protection/Control Acts: Air (prevention and control of pollution) act 1981, Forest conservation act (1980 and 1992), Wildlife protection act 1972, Environment protection act 1986, Issues involved in enforcement of environmental legislations

Green Methodology: Principles of green chemistry, Green methods in electronic production, Impact of electronic waste on public health and environment;United nations goals of sustainable development

SelfLearningTopics(SLTs):*Water (prevention and control of pollution) act 1974(Text1: unit 6, topics 6.10), Water pollution cess act 1977(Text1: unit 6, topics 6.11)*

Course Learning Outcomes(COs):

Aftercompletion of this course, the students should be able to…

CO1: identify the natural resources and practice their usage more equitably
CO2: develop an action plan for sustainable alternatives and conserving biodiversity

CO3: examine and perceive the solutions for the environmental pollution

CO4: adapt issues involved in enforcement of environmental legislationand green methodology

Text Book(s):

1. Erach Bharucha,*TextBook of Environmental Studies for Under Graduate Courses,* ***2nd ed., Universities Press (India) Pvt. Ltd, 2013***

Reference Book(s):

1. Y. Anjaneyulu, *Introduction to Environmental Science*, B.S. Publications, 2004.
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd Ed., Prentice Hall of India,1991
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 4th Ed., New Age International Publishers, 2014
4. R.Rajagopalan, *Environmental Studies from crisis to cure*, , 2nd Ed., Oxford University Press, 2011

Weband Video link(s):

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ch27/
   video lecture on renewable energy resources by Prof. Vaibhav. V. Goud and Dr. R. Anandalakshmi, Dept. Of Chemical Engineering, Guwahati.

CourseArticulationMatrix(CAM):				**U24CY411 : ENVIRONMENTAL STUDIES**										
CO		**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24CY411.1**	2	1	2	1	-	2	1	1	1	1	1	1	1
CO2	**U24CY411.2**	-	-	2	-	-	2	1	1	1	1	1	1	1
CO3	**U24CY411.3**	1	2	1	-	-	1	1	1	1	1	1	1	1
CO4	**U24CY411.4**	-	-	1	-	-	2	1	1	1	1	1	1	1
U24CY411		**1.50**	**1.50**	**1.50**	**1**	**-**	**1.75**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रौद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
Estd-1980
KITSW
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

Semester -IV Exit Option Syllabi

Bridge Courses for exit:

Successful completion of twosubjects (6-Credits)during 2-months internship at the institute

OR

Successful completion of twosuitable skill based courses (external) to qualify for Certification

B. After Second Year: (UG Diploma in CSE (AI & ML))

(i) The candidate should pass any two of the following additional courses (Diploma Level) during the 2-Months internship at institute

Abbreviations

L	Lecture Hour	O	Outside the Class Work (Self Study) Hours
T	Tutorial Hour	E	Total Engagement in Hours
P	Practical Hour	C	Credit Assigned

Exit Option to Qualify UG Diploma in CSE (AI & ML): Any Two (02) Courses during the 2 - Months internship									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	PCC	U24AI412X	Machine Learning	2	-	2	-	4	3
2	PCC	U24AI413X	Computer Vision and Image Processing	2	-	2	-	4	3
3	PCC	U24AI414X	Data Warehousing and Data Mining	2	-	2	-	4	3
4	PCC	U24AI415X	Web Technologies	2	-	2	-	4	3
5	PCC	U24AI416X	Any other course approved by BoS Chair and Dean AA	2	-	2	-	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for Diploma.

Exit Option to Qualify UG Diploma in in CSE (AI & ML): Any Two (02) Skill based Courses -:									
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**O**	**E**	**C**
1	SEC	U24SE417X	Introduction to Machine Learning using Python Reference: https://www.shiksha.com/online-courses/machine-learning-course-dcodl2	-	-	6	-	6	3

Exit Option to Qualify UG Diploma in in CSE (AI & ML): Any Two (02) Skill based Courses -:									
S. No.	Category	Course Code	Course Title	L	T	P	O	E	C
2	SEC	U24SE418X	**Introduction to Computer Vision** **Reference:** https://onlinecourses.nptel.ac.in/noc19_cs58/preview	-	-	6	-	6	3
3	SEC	U24SE419X	**R Programming for Data Analytics** **Reference:** https://onlinecourses.nptel.ac.in/noc19_ma33/preview	-	-	6	-	6	3
4	SEC	U24SE420X	**Pattern Discovery in Data Mining** **Reference:** https://www.coursera.org/learn/data-patterns	-	-	6	-	6	3
5	SEC	U24SE421X	**Introduction to Web Programming** **Reference:** https://www.shiksha.com/online-courses/web-developer-version-2-course-nsnaskl2	-	-	6	-	6	3
6	SEC	U24SE422X	**Software Testing Methodologies** **Reference:** https://onlinecourses.nptel.ac.in/noc22_cs61/preview	-	-	6	-	6	3
7	SEC	U24SE423X	Any other course approved by BoS Chair and Dean AA	-	-	6	-	6	3

B. Tech Honours with Research:

Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-I (5 Credits) at respective department during the summer vacation after IV Semester.

MACHINE LEARNING

Class: B.Tech. IV – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI412X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: analyze machine learning fundamentals, concept learning, and the general-to-specific ordering of hypotheses for solving learning problems

LO2: apply supervised learning techniques to build classification, regression, and probabilistic learning models

LO3: design artificial neural network architectures and apply unsupervised learning techniques for pattern discovery and dimensionality reduction

LO4: analyze and apply ensemble learning and reinforcement learning techniques for intelligent decision-making and predictive modeling

THEORY COMPONENT

UNIT-I	4 Hrs

Introduction to Machine Learning: Examples of various learning paradigms, Designing a learning system, Perspectives and issues in machine learning, Model evaluation metrics

Concept Learning: Introduction, A concept learning task- inductive learning hypothesis, Concept learning as search- general-to-specific ordering of hypotheses, Find-S- finding a maximally specific hypothesis, Version spaces and the candidate - elimination learning algorithms

UNIT-II	4 Hrs

Supervised Learning: Learning a class from examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision trees: ID3, Classification and regression trees (CART), **Regression:** Linear regression and logistic regression, Support vector machines: Linear and non- linear, Kernel functions, K-nearest neighbors, Naïve bayes classifier

UNIT-III	4 Hrs

Artificial Neural Networks: Introduction, Neural network representations, Appropriate problems for neural network learning, Perceptron, Multilayer networks and the back propagation algorithm

Unsupervised Learning: Introduction to clustering, Partitional: K-means clustering, Dimensionality reduction- Principal components analysis (PCA)

UNIT-IV	4 Hrs

Ensemble Learning: Boosting – AdaBoost, Stacking, Bagging - random forests, Different ways to combine classifiers

Reinforcement Learning: The learning task, SARSA and Q-Learning, Non-deterministic, Rewards and Actions

LABORATORY COMPONENT

List of Experiments

1. Build a basic learning system that takes input data, processes it, and makes predictions.

   Tasks:

   i. Define a machine learning problem (e.g., spam detection, digit recognition).
   ii. Preprocess the data (handle missing values, normalize features).
   iii. Train a simple model (e.g., decision tree) and evaluate performance.

2. Make use of the given dataset and implement the Find-S algorithm to find the most specific hypothesis.

   Sample dataset:

Sky	Temp	Humidity	Wind	Water	EnjoySport
Sunny	Warm	Normal	Strong	Warm	Yes
Sunny	Warm	High	Strong	Warm	Yes
Rainy	Cold	High	Strong	Warm	No
Sunny	Warm	High	Strong	Cool	Yes

3. Develop a python program for the following: -

   i. Linear regression
   ii. Logistic regression

4. Build a linear and non-linear SVM on an appropriate dataset.

5. Develop a python code for KNN Algorithm for classification.

   Note:- Choose an optimal value of K using cross-validation.

6. Build an Artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.

7. Develop K-Means clustering on the PCA-transformed data.

   Note: - Use the elbow method to determine the optimal number of clusters (K)

   And plot the Within-Cluster Sum of Squares (WCSS) against the number of clusters to identify the "elbow point".

8. Make use of ensemble techniques and implement bagging and train a Random Forest model.

   Tasks:

i. Train a single decision tree vs. random forest.
ii. Compare bias-variance tradeoff.
iii. Tune number of estimators and analyze performance.

9. Develop a python code for AdaBoost on an appropriate data set.
10. Develop a python code for SARSA (State-Action-Reward-State-Action) and Q-Learning reinforcement learning problems.

Text Book(s):

1. Tom M. Mitchell, *Machine Learning*, Indian ed., Chennai: McGraw-Hill Education, 2017. (*Chapters 1,2,4*)
2. Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, 2nd ed., New York: CRC Press, 2014. (*Chapters 6, 7, 8, 11, 12, 13 and 14*)

Reference Book(s):

1. Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, 1st ed., New York: Cambridge University Press, 2012.
2. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., New York: Pearson Education, 2020.
3. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, 2nd ed., USA: John Wiley & Sons, 2020.
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences: Neural Networks and kernels*, 1st ed., Cambridge: Cambridge University Press, 2009.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs81/course; *NPTEL Video Lecture on Introduction To Machine Learning – IITKGP by Prof. Sudeshna Sarkar, Professor of CSE, IIT Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc24_cs101/course; *NPTEL Video Lecture on Introduction to Machine Learning by Prof. Balaraman Ravindran, Professor of CSE, IIT Madras and Mindtree Faculty Fellow.*

Laboratory Manual (for laboratory component):

1. *Machine Learning Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze learning paradigms, apply concept learning and design effective machine learning systems

CO2 : apply supervised learning techniques, build classification and regression models, and design probabilistic learning solutions for real-world problems

CO3 : apply unsupervised learning techniques for data exploration, use dimensionality reduction methods for feature optimization, and build neural networks for predictive modelling tasks

CO4 : make use of ensemble methods to improve models and apply reinforcement learning for decision-making

(based on psychomotor skills acquired from laboratory component)

CO5 : develop machine learning models and analyze the key challenges like over fitting and hypothesis selection

CO6 : build machine learning models for regression and classification and analyze their performance on real-world datasets

CO7 : design neural networks with backpropagation, implement K-Means clustering, apply PCA for feature reduction

CO8 : develop ensemble models, implement reinforcement learning algorithms like SARSA and Q-Learning

Course Articulation Matrix (CAM):						**U24AI412X : MACHINE LEARNING**								
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI412X.1**	1	2	2	1	-	-	1	1	1	-	1	2	2
CO2	**U24AI412X.2**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO3	**U24AI412X.3**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO4	**U24AI412X.4**	2	2	3	3	-	-	1	1	1	-	2	2	2
CO5	**U24AI412X.5**	1	2	2	2	2	-	1	2	1	2	1	2	2
CO6	**U24AI412X.6**	2	2	2	2	2	-	1	2	1	2	2	2	2
CO7	**U24AI412X.7**	2	2	2	2	2	-	1	2	1	2	2	2	2
CO8	**U24AI412X.8**	2	2	3	2	2	-	1	2	1	2	2	2	2
U24AI412X		**1.75**	**2**	**2.25**	**2**	**2**	**-**	**1**	**1.5**	**1**	**2**	**1.75**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Analyze learning paradigms, apply concept learning, and design effective machine learning systems	SDG 4	Quality Education	Machine learning fundamentals, concept learning, and system design enhance computational thinking, problem-solving ability, and advanced technical education.
CO2	Apply supervised learning techniques, build classification and regression models, and design probabilistic learning solutions for real-world problems	SDG 9	Industry, Innovation and Infrastructure	Classification and regression models are widely used in intelligent industrial systems, predictive analytics, automation, and innovation-driven applications.
CO3	Build neural networks, apply unsupervised learning techniques, and dimensionality reduction techniques	SDG 9	Industry, Innovation and Infrastructure	Neural networks and intelligent data analysis techniques support the development of innovative AI-enabled products, services, and digital infrastructure.
CO4	Make use of ensemble methods to improve models and apply reinforcement learning for decision-making	SDG 9	Industry, Innovation and Infrastructure	Reinforcement learning and ensemble techniques enable intelligent decision-making systems used in robotics, automation, smart industries, and advanced AI solutions.
CO5	Design learning systems, develop machine learning models, and analyze key challenges like overfitting and hypothesis selection	SDG 4	Quality Education	Practical implementation of machine learning systems develops analytical skills, technical competence, and lifelong learning capabilities.
CO6	Build machine learning models for regression and classification and analyze their performance on real-world datasets	SDG 9	Industry, Innovation and Infrastructure	Real-world data-driven model development promotes innovation and intelligent solutions across healthcare, agriculture, manufacturing, and business sectors.
CO7	Design neural networks with backpropagation, implement K-Means clustering, and apply PCA for feature reduction	SDG 9	Industry, Innovation and Infrastructure	Advanced machine learning techniques improve data processing efficiency and contribute to intelligent infrastructure and technological innovation.
CO8	Develop ensemble models in Python and implement SARSA and Q-Learning	SDG 8	Decent Work and Economic Growth	AI-driven automation and intelligent optimization techniques enhance productivity, support emerging technology jobs, and contribute to sustainable economic growth.

COMPUTER VISION AND IMAGE PROCESSING

Class: B.Tech. IV – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI413X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: fundamental concepts of image processing such as basic relationship between pixels, intensity transformation and spatial filtering techniques

LO2: morphological image processing techniques applied on input images to filter the objects present in an input image

LO3: image segmentation techniques applied on input images to segment the objects present in an input image

LO4: providing vision to a computer by extracting the features from an object present in an input image and identify the object using classification techniques

THEORY COMPONENT

UNIT-I	4 Hrs

Introduction: What is digital image processing, Examples of fields that use digital image processing, Fundamental steps in digital image processing

Digital Image Fundamentals: Some basic relationships between pixels, Introduction to the mathematical tools used in digital image processing

Intensity Transformations & Spatial Filtering: The basics of intensity transformations and spatial filtering, Basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods.

UNIT-II	4 Hrs

Morphological Image Processing: Preliminaries, Erosion and dilation, Opening and closing, Hit-or-miss transformation, Some basic morphological algorithms

UNIT-III	4 Hrs

Image Segmentation: Fundamentals, Point, Line and edge detection, Thresholding, Segmentation by region growing and by region splitting and merging, Region segmentation using clustering and superpixels, Segmentation using morphological watersheds

UNIT-IV	4 Hrs

Feature Extraction: Background, Boundary preprocessing, Boundary feature descriptors, Region feature descriptors, Principal components as feature descriptors, Whole-image features, Scale-invariant feature transform

Image Pattern Classification: Background, Patterns and pattern classes, Pattern classification by prototype matching, Optimum (Bayes) statistical classifiers

LABORATORY COMPONENT

List of Experiments

1. Develop a program to apply various affine transformations to an input image.
2. Develop a program to apply basic intensity transformation functions.
3. Develop a program to implement contrast stretching and intensity level slicing.
4. Develop a program to implement histogram processing on an input image.
5. Develop a program to implement various smoothing linear and non-linear filters.
6. Develop a program to demonstrate erosion, dilation, opening and closing morphological operation.
7. Develop a program to demonstrate boundary extraction, convex hull, thinning, and thickening and skeletonization morphological operation.
8. Develop a program demonstrate various segmentation techniques.
9. Develop a program to demonstrate various feature extraction techniques.
10. Develop a program to for object detection using various classification techniques.

Text Book(s):

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, 4th ed., New York: Pearson, 2018. *(Chapters 1 to 3, 9 to 12)*

Reference Book(s):

1. Anil K. Jain, *Fundamentals of Image Processing*, 1st ed., Chennai: Pearson, 2015.
2. B. Chanda, D. Dutta Majunder, *Digital Image Processing and Analysis*, 2nd ed., New Delhi: Prentice Hall of India, 2011.
3. S. Sridhar, *Digital Image Processing*, 2nd ed., Noida: Oxford University Press, 2016.
4. Munesh C. Trivedi, *Digital Image Processing*, 1st ed., New Delhi: Khanna Book Publishing, 2014.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_ee116/preview; *NPTEL Video Lecture on Dital Image Processing by Prof. Prabir Kumar Biaswas, Professor of EEE, IIT Kharagpur.*

Laboratory Manual (for laboratory component):

1. *Computer Vision and Image Processing Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply the image pre-processing techniques such as intensity transformation & filtering techniques to enhance the look and feel of an input image for further processing

CO2: apply morphological image processing techniques on objects present in input images to extract image components present in the input images

CO3: apply various segmentation techniques to segment the objects present in the input images for further processing

CO4: extract the features to depict the shape of an object and apply classification techniques to identify the object present in an input image

(based on psychomotor skills acquired from laboratory component)

CO5: develop programs to enhance the look and feel of the image by using various intensity transformation and filtering techniques

CO6: apply various morphological algorithms to extract the components of an input image for further processing

CO7: apply various segmentation techniques to extract the components of an input image for further processing

CO8: develop programs to extract the features from input image for identification and classification of the objects

Course Articulation Matrix (CAM):				**U24AI413X : COMPUTER VISION AND IMAGE PROCESSING**										
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI413X.1**	1	2	2	1	-	-	1	1	1	-	1	2	2
CO2	**U24AI413X.2**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO3	**U24AI413X.3**	2	2	2	2	-	-	1	1	1	-	2	2	2
CO4	**U24AI413X.4**	2	2	3	3	-	-	1	1	1	-	2	2	2
CO5	**U24AI413X.5**	1	2	2	2	2	-	1	2	1	2	1	2	2
CO6	**U24AI413X.6**	2	2	2	2	2	-	1	2	1	2	2	2	2
CO7	**U24AI413X.7**	2	2	2	2	2	-	1	2	1	2	2	2	2
CO8	**U24AI413X.8**	2	2	3	2	2	-	1	2	1	2	2	2	2
U24AI413X		**1.75**	**2**	**2.25**	**2**	**2**	-	**1**	**1.5**	**1**	**2**	**1.75**	**2**	**2**

DATA WAREHOUSING AND DATA MINING

Class: B.Tech. IV – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI414X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: data warehouse architecture, multidimensional modelling and preprocessing
LO2: algorithms for mining frequent patterns and Association rules
LO3: classification models and relevant evaluation techniques
LO4: clustering techniques and data mining applications on web, finance and retail business

THEORY COMPONENT

UNIT-I	4 Hrs

Data Warehouse: Basic concepts, Multitier architecture, Data warehouse models, ETL tools, Metadata repository

Multidimensional Data Modelling: Data cube, Star, Snowflake and Fact constellation schemas, Dimensions, Measures, OLAP operations, Star net query model

Data Warehouse Implementation: Efficient data cube computation, Indexing OLAP, Efficient processing of OLAP queries, OLAP servers

UNIT-II	4 Hrs

Data Preprocessing: Data cleaning, Integration, Reduction and Transformation

Data Mining: Introduction, Types of data and patterns can be mined, Technologies used, Major issues in data mining

Association Rule Mining: Basic concepts, Apriori algorithm, Generating association rules from frequent item sets, Improvements of Apriori algorithm

UNIT-III	4 Hrs

Classification: Basic concepts, Classification by decision tree induction, Bayesian classification, Rule based classification, Model evaluation and Selection

Advanced Classification: Classification by back propagation, Associative classification, K Nearest Neighbor classifiers

UNIT-IV	4 Hrs

Cluster Analysis: Introduction, Types of data in cluster analysis, Partitioning methods by K- Means and K-Medoids, Hierarchical clustering, BIRCH, DBSCAN algorithm, Grid based method with STING, Evaluation of clusters

LABORATORY COMPONENT

List of Experiments

Unit-1:

1. Implement multidimensional data models like Star Schema, Snowflake Schema, and Fact Constellation Schema using SQL, typically follow these steps:
   Create dimension and fact tables
   Insert sample data.
   Run queries to demonstrate OLAP-style analysis (e.g., aggregations).
   Dataset: **Sales Data Warehouse**.
   1.Star Schema
   Tables: FactSales: Stores measurable data.
   DimCustomer, DimProduct, DimStore, DimDate: Denormalized dimension tables
   2. Snowflake Schema
   Normalize dimensions (e.g., categories in separate tables)
   3. Fact Constellation Schema (Galaxy Schema)
   Multiple fact tables sharing dimensions
   Add a new fact table for Inventory.
2. Implement CUBE operations using SQL on the Sales Data Warehouse dataset, use the GROUP BY CUBE clause. This allows us to compute aggregations across multiple dimensions, producing subtotals and a grand total in a single query.
   Tables:
   1. **FactSales**(DateID, CustomerID, ProductID, StoreID, SalesAmount, Quantity)
   2. **DimDate**(DateID, Year, Month)
   3. **3.DimProduct**(ProductID, ProductName, Category)
   4. **4.DimCustomer**(CustomerID, CustomerName, Region)
   5. **5.DimStore**(StoreID, StoreName, Location)

   1. Sales by Year, Category, and Region with CUBE
   2. Quantity Sold by Product, Store, and Month
3. Implement Set Operations in SQL (using UNION, INTERSECT, EXCEPT) on multidimensional data models e.g., a Sales Data Warehouse), perform comparative analysis between subsets of data.
   Use FactSales and related dimension tables like:
   1. **DimCustomer**
   2. **DimProduct**
   3. **DimStore**
   4. **DimDate**

   1. **UNION –** Combine Results from Two Queries
      Example: Customers who bought either electronics or clothing
   2. **INTERSECT** – Common Entries in Two Queries
      Example: Customers who bought both electronics and clothing
   3. **EXCEPT (or MINUS)** – Find Items in One Set Not in Another
      Example: Customers who bought electronics but not clothing.
4. Develop a data warehouse application for sales management using ETL tool

Unit-2:

1. Perform data preprocessing/analysis tasks using WEKA Tool.
2. Write a program in any programming language to create a file in ARFF format consisting of at least 10,000 transactions with at least three items.
3. Write a program to implement Apriori algorithm for association rule mining.

4. Generate association rules using Apriori and FP-Growth methods in WEKA Tool on German credit card dataset.

Unit-3:

1. a) Write a program to implement ID3 classification algorithm.
   b) Generate and compare different classification functions of WEKA Tool on German credit card dataset.
2. Generate the significance of attributes Foreign worker and social status of German credit card dataset in classification process using WEKA Tool.
3. Generate and compare significance of Ten cross fold and Fifty cross fold options of testing data generation for classification using WEKA Tool.
4. Generate and compare significance of Cross validation and boot strapping techniques of evaluation using WEKA Tool.

Unit-4:

1. Write a program to implement simple K-means Clustering algorithm using WEKA Tool.
2. Generate and compare different clustering functions of WEKA Tool on German credit card dataset.
3. Generate the significance of attributes foreign worker and social status of German credit card dataset in clustering process using WEKA Tool.
4. Case Study: Retail Industry – Market Basket Analysis

Text Book(s):

1. Jiawei Han, Micheline Kamber, *Data Mining Concepts and Techniques*, 3rd ed., Singapore: Morgan Kaufmann Publishers, 2016. (*Chapters 1, 3, 4, 5, 6, 8, 10*)

Reference Book(s):

1. Sam Anahory, Dennis Murray, *Data warehousing in the real world*, 1st ed., New Delhi: Pearson, 2003.
2. C.S.R. Prabhu, *Data Warehousing Concepts, Techniques, Products and Applications*, 2nd ed., New Delhi: PHI Learning Private limited, 2002.
3. Arun K. Pujari, *Data Mining Techniques*, 2nd ed., Hyderabad: Universities Press (India) Pvt. Ltd, 2010.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview; *NPTEL Video Lecture on Data Mining Processing by Prof. Pabitra Mitra, Professor of CSE, IIT Kharagpur*.

Laboratory Manual (for laboratory component):

1. *Data Warehousing and Data Mining Laboratory Manual and Record Book*, Department of CSE (Data Science), KITSW

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,
(based on cognitive skills acquired from theory component)

CO1: apply various techniques to design and develop data warehouse and data mining systems

CO2 : apply frequent pattern mining techniques on data sets for association rules extraction

CO3: analyse efficiency based on classification algorithms

CO4:	evaluate clustering techniques and design data mining applications on web financial domains.

(based on psychomotor skills acquired from laboratory component)

CO5: design data warehouse and implement OLAP operations

CO6: apply ETL & OLAP tools for data analysis

CO7: evaluate different data processing techniques using WEKA tool

CO8: implement data mining techniques on various data sets

Course Articulation Matrix (CAM):		**U24AI414X : DATA WAREHOUSING AND DATA MINING**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24AI414X.1**	1	2	2	2	1	-	-	1	1	1	1	2	1
CO2	**U24AI414X.2**	1	2	2	2	-	-	-	1	1	-	1	2	1
CO3	**U24AI414X 3**	1	2	2	2	1	-	-	1	1	-	1	2	1
CO4	**U24AI414X.4**	1	2	2	2	-	-	-	1	1	-	1	2	1
CO5	**U24AI414X.5**	1	2	2	2	1	-	-	1	1	1	1	2	2
CO6	**U24AI414X.6**	1	2	2	2	-	-	-	1	1	-	1	2	2
CO7	**U24AI414X.7**	1	2	2	2	1	-	-	1	1	-	1	2	2
CO8	**U24AI414X.8**	1	2	2	2	-	-	-	1	1	1	1	2	2
U24AI414X		**1**	**2**	**2**	**2**	**1**	-	-	**1**	**1**	**1**	**1**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

WEB TECHNOLOGIES

Class: B.Tech. IV – Semester (Exit Course)		Branch: CSE (AI & ML)	
Course Code:	**U24AI415X**	**Credits:**	**3**
Hours/Week (L-T-P-O-E):	**2-0-2-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**32 Hrs**	**ESE:**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: creating basic HTML webpages using essential tags, headings, links, images, tables, frames and forms with controls

LO2: CSS for styling web pages and JavaScript for enhancing interactivity and functionality

LO3: creating dynamic web pages using advanced JavaScript (including ES6+) and integrate with ReactJS

LO4: gain hands-on experience in building modular and maintainable web applications using React components and hooks

THEORY COMPONENT

UNIT-I	4 Hrs

HTML: Document structure, Basic tags, Creating headings, Working with links, Creating paragraph, Working with images, Tables, Frames, Introduction to forms and Controls: Creating HTML form, Specifying action URL and method to send the form, Using html controls

UNIT-II	4 Hrs

CSS: CSS (Cascading style sheet) rules and properties, Types: Inline, External and Internal Style sheets, Style classes, Multiple styles

JavaScript: JavaScript syntax, Embedding JavaScript in HTML page, Usage of variables, Working with operators, Control – flow statements, Functions, Arrays, Creating objects, Handling events

UNIT-III	4 Hrs

JavaScript for React: Declaring variables, Creating functions, Objects and arrays, The spread operator asynchronous javascript, Simple promises with fetch, Async/await, Building promises classes, ES6 modules, CommonJS, Functional programming with javascript

UNIT-IV	4 Hrs

Fundamentals of React: Hello React, Setting up a React project, Meet the React, Component, React JSX, Lists in React, React component instantiation, React DOM

LABORATORY COMPONENT

List of Experiments

1. Design the following static web pages with the following attributes:
   a. Basic Tags.
   b. Heading Tags.
   c. List (Ordered, Un-Ordered and Description).
   d. Textbox, Buttons
2. Design the following static web pages required for an online book store web site.

a. Home page.
b. Login page.
c. Catalogue page.

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart
CSE CSE(AI&ML) CSE(Data Science) CSE(Networks) CSE(IoT)	Login: Password: Submit: Reset:			

3. Develop a form for student registration with fields name, roll no, gender, qualification, DOB, Email-id, phone number and submit button.
4. Build a style sheet template using Inline, Internal, External.
5. Design a registration form and validate its field by using JavaScript.
6. Export and Import modules using ES6 export / import.
7. Destructure an Object and log each variable.
8. Refactor the fetch () example using async/await.
9. Use Fragment to avoid extra DOM elements.
10. Create a Responsive layout with CSS in React.

Text Book(s):

1. Kogent, *Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, 1st ed., New Delhi: Dreamtech Press, 2013. (*Chapters 2 to 7*)
2. Alex Banks, Eve Porcello, *Learning React Modern Patterns for Developing React Apps*, 2nd ed. Delhi: Greyscale Indian Edition, 2020

Reference Book(s):

1. Ivan Bayross, *Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP*, 4th ed., New Delhi: BPB Publications, 2009.
2. Uttam K.Roy, *Web Technologies*, 7th ed., New Delhi: Oxford Higher Education 2010.
3. Nabendu Biswas, *Ultimate Full – Stack Web Development with MERN: Design, Build Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS*, 1st ed., Delhi: AVA Publisher, 2021.

Web and Video link(s):

1. https://onlinecourses.swayam2.ac.in/nou25_cs09/preview?; *NPTEL Video Lecture on Web Technology by Dr. Ashutosh Kumar Bhatt, Uttarakhand Open University, Haldwani.*

Laboratory Manual (for laboratory component):

1. *Web Technologies Laboratory Manual and Record Book*, Department of CSE (Data Science),

KITSW
Course Learning Outcomes (COs) *After completion of this course, the students should be able to,* *(based on cognitive skills acquired from theory component)* **CO1:** apply structured HTML using various tags and forms, and analyze their usability and data handling **CO2:** make use of CSS for styling and JavaScript for behaviour control and event handling to develop dynamic and interactive web pages **CO3:** implement client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts **CO4:** develop and manage modular web applications using ReactJS and modern frontend development practices *(based on psychomotor skills acquired from laboratory component)* **CO5:** develop and test web pages using HTML tags, forms, and controls for creating headings **CO6:** apply various CSS styles to build a style sheet template that enhances the presentation and maintainability of web pages and JavaScript **CO7:** build interactive UI components using ReactJS, including hooks and functional programming practices **CO8:** develop full-stack applications with React as frontend and JSP/JDBC as backend, showcasing complete web flow

Course Articulation Matrix (CAM):				**U24AI415X : WEB TECHNOLOGIES**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PSO1**	**PSO2**
CO1	**U24AI415X.1**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO2	**U24AI415X.2**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO3	**U24AI415X.3**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO4	**U24AI415X.4**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO5	**U24AI415X.5**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO6	**U24AI415X.6**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO7	**U24AI415X.7**	2	2	2	1	2	1	-	2	1	2	1	2	2
CO8	**U24AI415X.8**	2	2	2	1	2	1	-	2	1	2	1	2	2
U24AI415X		2	2	2	1	2	1	-	2	1	2	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

Semester -V Syllabi

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE	U24OE501X-SD	Open Elective –SDGB (Pool - XVI)	2	1	-	3	3
2	PCC	U24AI502	Web Programming	2	1	-	3	3
3	PCC	U24AI503	Design and Analysis of Algorithms	2	1	-	3	3
4	PCC	U24AI504	Machine Learning	2	1	-	3	3
5	IKSC	U24IK506B	Universal Human Values-II	2	-	-	2	2
6	PCC	U24AI509	Web Programming Laboratory	-	-	2	2	1
7	PCC	U24AI510	Design and Analysis of Algorithms Laboratory	-	-	2	2	1
8	PCC	U24AI511	Machine Learning Laboratory	-	-	2	2	1
9	ELC	U24AI512	Seminar	-	-	2	2	1
			Total:	10	4	8	22	18
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	23
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				NIL				

Pool - XVI Sustainable Development Goals Basket (OE - SDGB)		
S. No.	Course Code	Course Title
1.	U24OE501A-SD	Sustainable Waste Management and Circular Economy
2.	U24OE501B-SD	Carbon Reduction & Net Zero
3.	U24OE501C-SD	Renewable Energy Systems
4.	U24OE501D-SD	Sustainable Embedded Solutions for Smart Cities and Healthcare
5.	U24OE501Z-SD	Any other course approved by BoS Chair and Dean AA

SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY

Class: B. Tech. V – Semester		**Branch:** Common to All branches	
Course Code:	**U24OE501A-SD**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total No of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1: appraise the concept of waste management

CO2: analyze activities associated with the management of hazardous wastes

CO3: apply the concept of circular economy and conduct relevant research

CO4: create business models for sustainable development using complex aspects of circular economy

UNIT-I	9 Hrs

Waste management: Introduction, Context and overview of waste management, Waste landscape in India, Hierarchy of waste management, Sources of waste and waste streams, Challenges and opportunities in waste management

Strategies for Waste management: Need for National Waste Management Strategies (NWMS), Concepts and principles, Objectives, Goals and targets, Policy tools for waste management, Process of developing NWMS, Implementation of NWMS, Roles and responsibilities of various sectors, Supporting initiatives of public and private domains, International recommendations and mandates

UNIT-II	9 Hrs

Elements of Hazardous waste management: Hazardous waste definition, S ources, Identification and classification, Collection, Handling, Storage and transport, Hazardous waste management rules and regulations, Treatment technologies, Hazardous waste disposal, Hazardous waste landfills-Site selections, Design and operation. Hazardous waste reduction, Recycling and reuse, Remediation of hazardous waste contaminated sites

Management of different Hazardous waste: Sources, Production, Collection, Segregation, Treatment and disposal of hazardous wastes - Plastic waste - Biomedical waste - E-waste-nuclear waste - Global and Indian Context, Hazardous Waste Management Practices – Health and environmental effects, Recycling, Energy production, Landfilling, Other applications

UNIT-III	9Hrs

Introduction to Circular Economy: Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs Circular Economy

Characteristics of Circular Economy: Material recovery, Waste reduction, Reducing negative externalities, Explaining butterfly diagram, Concept of loops

UNIT-IV	9Hrs

Circular design, innovation and Assessment: Zero waste- Waste Management in context of Circular Economy, Circular design, Research and innovation, Life Cycle Assessment (LCA), Circular Business Models

Case Studies and Legal policy framework: Business models, Solid Waste Management / Wastewater, Plastics: A case study, EPR: polluters pay principle, Industrial symbiosis/ Eco-parks, Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG

Textbook(s):

1. *Guidelines For National Waste Management Strategies: Moving from Challenges to Opportunities*—UNEP-United Nations Institute for Training and Research-2013- *ISBN: 978-92-807-3333-4.*
2. *Waste Management Practices: Municipal, Hazardous and Industrial,* John Pichtel, CRC Press, 2014, 2nd Edition.
3. *Integrated Solid Waste Management, Engineering Principles and Management Issues,* Tchobanoglous G, Theisen H and Vigil SA, McGraw Hill Education, 2014.

Reference Book(s):

1. *Guidelines For National Waste Management Strategies: Moving from Challenges to Opportunities*—UNEP-United Nations Institute for Training and Research-2013- *ISBN: 978-92-807-3333-4.*
2. *National Waste Management Strategy 2020- Minister of Forestry, Fisheries and the Environment,* Republic of South Africa.
3. *Circular Economy: A Credit Point Course*, Proposed by International Council for Circular Economy (ICCE) New Delhi, In Collaboration with All India Council for Technical Education (AICTE) New Delhi.
4. *The Circular Economy A User's Guide,* Walter R Stahel Routledge; 1st Edition (24 June 2019)
5. Circular Economy: (Re) Emerging Movement Shalini Goyal Bhalla Invincible Publisher
6. *The Circular Economy Handbook: Realizing The Circular Advantage,* Peter Lacy, Jessica Long, Wesley Spindler Palgrave Macmillan UK.
7. *Waste to Wealth: The Circular Economy Advantage Peter Lacy*, Jakob Rutqvist Palgrave Macmillan.

Web and Video link(s):

1. https://nptel.ac.in/courses/105105160, *NPTEL Course on Integrated Waste Management for a Smart City (Municipal Solid Waste, C&D Waste, E-Waste, NWMS, Waste Hierarchy, Policy Tools, Composting, Landfilling) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*
2. ***https://nptel.ac.in/courses/105105169,*** *NPTEL Course on Electronic Waste Management – Issues and Challenges (E-Waste Generation, Biomedical, Plastic & Hazardous Waste Rules, Recycling, Landfill Design, Remediation) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*
3. ***https://nptel.ac.in/courses/105103205,****NPTEL Course on Municipal Solid Waste Management (Circular Economy Principles, Material Recovery, LCA, Butterfly Diagram, Waste Reduction & Loop Strategies) by IIT Guwahati.*
4. ***https://onlinecourses.nptel.ac.in/noc25_ce122/preview*** *NPTEL Course on Integrated Waste Management for a Smart City – 2025 Edition (Circular Business Models, EPR, Industrial Symbiosis, ESG, Zero-Waste Strategies, India CE Policy Framework) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*

Course Articulation Matrix (CAM):				U24OE501A-SD : SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501A-SD.1	2	1	1	1	-	1	1	1	-	1	1	1	1
CO2	U24OE501A-SD.2	2	1	2	1	-	1	1	1	1	1	1	2	1
CO3	U24OE501A-SD.3	2	2	2	1	-	1	1	1	1	1	1	2	1
CO4	U24OE501A-SD.4	2	1	1	1	2	1	1	1	1	1	1	2	1
U24OE501A-SD		**2**	**1.25**	**1.25**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	appraise the concept of waste management	SDG 12	Responsible Consumption and Production	Appraising the waste management hierarchy, National Waste Management Strategies (NWMS), and policy tools for controlling waste streams directly promotes responsible consumption, sustainable production patterns, and significant reduction of waste generation across municipal, industrial, and hazardous waste sectors.
CO2	analyze activities associated with the management of hazardous wastes	SDG 11	Sustainable Cities and Communities	Analyzing collection, handling, treatment, landfill design, and regulatory compliance for hazardous wastes — including plastic, biomedical, e-waste, and nuclear waste — safeguards human health and environmental quality, contributing to the development of safe, resilient, and environmentally sustainable urban and industrial communities.
CO3	apply the concept of circular economy and conduct relevant research	SDG 9	Industry, Innovation and Infrastructure	Applying circular economy principles — material recovery, waste reduction, LCA, butterfly diagram, and loop strategies — and conducting innovation-driven research fosters sustainable industrial practices that decouple economic growth from resource depletion, supporting resilient and environmentally responsible industrial infrastructure.
CO4	Create business models for sustainable development using complex aspects of circular economy.	SDG 9	Industry, Innovation and Infrastructure	Creating circular business models — incorporating EPR, industrial symbiosis, eco-parks, zero-waste strategies, ESG frameworks, and India-specific CE policy goals — drives innovation-led, resource-efficient industry and contributes to inclusive, sustainable economic growth aligned with SDG 9 and the global circular economy agenda.

CARBON REDUCTION & NET ZERO

Class: B. Tech. V – Semester		**Branch:** Common to All branches	
Course Code:	**U24OE501B-SD**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : explain climate change, greenhouse gas emissions, carbon footprint assessment, and the need for carbon reduction

CO2 : apply carbon accounting methodologies, life cycle assessment techniques, and sustainability reporting frameworks

CO3 : analyse carbon reduction technologies, renewable energy integration, energy efficiency measures, and circular economy practices

CO4 : evaluate net-zero strategies, carbon markets, ESG frameworks, and organizational decarbonization pathways

UNIT-I	**9 Hrs**

Climate Change and Carbon Footprint: Introduction to climate change – Global warming and its impacts – Greenhouse gases (GHGs) and emission sources – Carbon cycle and climate systems – National and international climate initiatives – Paris Agreement and COP framework – Carbon footprint concepts – Organizational, product, and personal carbon footprints – Carbon footprint calculation methodologies – Scope 1, Scope 2, and Scope 3 emissions – Need for carbon reduction and net-zero transition

UNIT-II	**9 Hrs**

Carbon Accounting and Sustainability Assessment: Carbon accounting principles and methodologies – Greenhouse Gas Protocol – Emission factors and inventory development – Monitoring, reporting and verification (MRV) systems – Life Cycle Assessment (LCA) methodology – Environmental impact assessment – Carbon disclosure frameworks – Sustainability reporting standards – ESG fundamentals – Corporate sustainability metrics and reporting practices

UNIT-III	**9 Hrs**

Carbon Reduction Technologies and Strategies: Energy efficiency technologies – Green buildings and sustainable infrastructure – Renewable energy systems for decarbonization – Electrification of transportation – Electric vehicles and charging infrastructure – Smart energy management systems – Waste management and circular economy concepts – Resource efficiency – Industrial decarbonization technologies – Carbon capture, utilization and storage (CCUS)

UNIT-IV	**9 Hrs**

Net Zero Pathways and Carbon Markets: Net-zero concepts and frameworks – Science-based targets – Net-zero roadmaps for organizations and cities – Carbon neutrality versus net zero – Carbon credits and carbon trading mechanisms – Voluntary and compliance carbon markets – ESG regulations and policy frameworks – Climate risk assessment – Sustainable finance and green investments – Case studies on net-zero implementation in industries and institutions

Textbook(s):

1. Barry Murphy and James G. Piper, *Carbon Accounting and Management for Sustainability*, Routledge.
2. Catherine Richards and Andy Haines, *Carbon Reduction and Net Zero Transition*, Springer.

Reference Book(S):

1. Chris Goodall, *What We Need To Do Now: For a Zero Carbon Future*, Profile Books.
2. Duncan Clark, *The Rough Guide to Ethical Living and Carbon Reduction*, Rough Guides.
3. National Academies of Sciences, *Accelerating Decarbonization of the U.S. Energy System*, National Academies Press.
4. Intergovernmental Panel on Climate Change (IPCC), *Climate Change Assessment Reports*.

Web and Video link(s):

1. NPTEL – Climate Change and Sustainability
2. UN Sustainable Development Goals Learning Platform
3. IPCC Knowledge Portal
4. International Energy Agency (IEA) Learning Resources

Course Articulation Matrix (CAM):				U24OE501B-SD: CARBON REDUCTION & NET ZERO										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501B-SD.1	2	2	1	1	1	3	1	-	1	-	1	1	1
CO2	U24OE501B-SD.2	2	3	2	2	3	2	1	-	1	-	2	2	2
CO3	U24OE501B-SD.3	2	2	3	2	2	3	1	-	1	1	2	2	3
CO4	U24OE501B-SD.4	2	3	3	2	2	3	2	-	1	2	2	1	2
U24OE501B-SD		**2.0**	**2.5**	**2.25**	**1.75**	**2.0**	**2.75**	**1.25**	**-**	**1.0**	**1.5**	**1.75**	**1.5**	**2.0**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	explain climate change, greenhouse gas emissions, carbon footprint assessment and the need for carbon reduction.	SDG13	Climate Action	Understanding climate change science and greenhouse gas emissions provides the foundation for climate action and supports efforts to reduce global warming impacts.
CO2	apply carbon accounting methodologies, life cycle assessment techniques and sustainability reporting frameworks.	SDG12	Responsible Consumption and Production	Carbon accounting and life cycle assessment promote efficient resource utilization, sustainable production systems, and environmental responsibility.
CO3	analyse carbon reduction technologies, renewable energy integration, energy efficiency measures and circular economy practices.	SDG7	Affordable and Clean Energy	Renewable energy technologies, energy efficiency improvements, and sustainable resource management contribute to clean and affordable energy systems.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	evaluate net-zero strategies, carbon markets, ESG frameworks and organizational decarbonization pathways.	SDG9, SDG11	Industry, Innovation and Infrastructure; Sustainable Cities and Communities	Net-zero implementation requires innovative infrastructure, sustainable industrial practices, climate-resilient cities, and effective environmental governance.

RENEWABLE ENERGY SYSTEMS

Class: B. Tech. V – Semester		**Branch:** Common to All branches	
Course Code:	**U24OE501C-SD**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**40%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**60%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy

CO2 : analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy

CO3 : analyze the feasibility of harnessing of electric power from oceans and biomass

CO4 : select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell

UNIT-I	9 Hrs

Introduction: Conventional and non-conventional sources of energy – brief description of different renewable energy sources

Solar energy: Introduction to prospects of solar PV systems: Photovoltaic effect and electrical equivalent circuit of a PV cell, Dependence of a PV cell characteristic on temperature, Solar cell output characteristics, Solar maximum power point tracking (MPPT) using Perturb &Observe algorithm, Applications of solar PV systems- street lighting, Domestic lighting, Solar PV pumping systems

UNIT-II	9 Hrs

Wind energy: Principles of wind power, Evaluation of wind intensity, Operation of a wind turbine and wind power curve, Different types of wind turbine generators, Topography and classification of wind turbines and its applications

Geothermal Energy: Origin and types of geothermal energy, Operational difficulties, Liquid dominated systems

UNIT-III	9 Hrs

Energy from Oceans: Ocean temperature differences, Ocean waves, Energy from the waves, Introduction of tidal power, Basic principle of tidal power, Components of tidal power plants

Bioenergy: Introduction, Bio-mass conversion technologies, Photo synthesis, Biogas generation, Biogas from power plant wastes, Methods of maintaining biogas production, Utilization of biogas, Biogas gasification

UNIT-IV	9 Hrs

Chemical energy sources: Introduction to fuel cells, Principle of operation of fuel cell, Classification of fuel cells, Advantages, Disadvantages and applications of fuel cells

Types of energy storage systems: Introduction, Mechanical energy storage systems, Batteries, Ultra-capacitors, Super conducting magnetic storage, Applications

Textbook:

1. Rai G.D, *Non-Conventional Energy Sources*, 4th edition. New Delhi: Khanna Publishers, 2010.

Reference Book(s):

1. B.H. Khan, *Non-conventional Energy Resources*, 2nd edition. New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2006.
2. Felix A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*, New Jersey: John Wiley & Sons, 2006.

3. Bansal N. K,Kaleeman, M.Miller, *Renewable Energy Sources and Conversion Technology*, New Delhi: Tata McGraw Hill Education (India) Pvt. Ltd., 2006.
4. Duffie and Beckman, *Solar Energy Thermal Process*, New Jersey: John Wiley & Sons, 2006.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ch40

Course Articulation Matrix (CAM):				U24OE501C-SD: RENEWABLE ENERGY SYSTEMS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE501C SD.1	3	3	2	1	2	2	1	1	1	1	2	3	3
CO2	U24OE501C-SD.2	3	3	2	1	2	2	1	1	1	1	2	3	3
CO3	U24OE501C-SD.3	3	2	2	1	1	3	1	1	1	1	2	2	2
CO4	U24OE501C-SD.4	3	2	2	1	2	2	1	1	1	1	2	3	2
U24OE501C-SD		**3**	**2.5**	**2**	**1**	**1.75**	**2.25**	**1**	**1**	**1**	**1**	**2**	**2.75**	**2.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement –** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy	SDG7	Affordable and Clean Energy	Smart grid concepts promote efficient, reliable, and sustainable electrical energy systems through intelligent monitoring, automation, and integration of clean energy resources.
CO2	analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy	SDG9	Industry, Innovation and Infrastructure	Smart grid computational tools, optimization methods, artificial intelligence, and automation technologies support innovation and modernization of power infrastructure.
CO3	analyze the feasibility of harnessing of electric power from oceans and biomass	SDG13	Climate Action	Distributed generation technologies such as renewable energy systems, microgrids, electric vehicles, and storage technologies contribute to reduction of greenhouse gas emissions and support climate-resilient energy systems.
CO4	select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell	SDG11	Sustainable Cities and Communities	Smart communication technologies, PMUs, WAMS, and intelligent control systems improve reliability, efficiency, and sustainability of urban power distribution systems and smart city infrastructure.

SUSTAINABLE EMBEDDED SOLUTIONS FOR SMART CITIES AND HEALTHCARE

Class: B.Tech. V Semester		**Branch:** Common to All branches	
Course Code:	**U24OE501D-SD**	**Credits:**	**03**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: make use of enabling technologies for sustainable smart cities and smart healthcare systems

CO2: develop embedded system model using the steps of embedded system development life cycle

CO3: develop embedded firmware using embedded 'C' programming

CO4: analyze hardware software co-design principles & program modelling techniques in embedded system design

UNIT-I	9 Hrs

Smart Cities: Importance of sustainable smart city, Driving and guiding principles to create sustainable smart cities, Potential components of sustainable smart city, Requirements of smart city, Key performance indicators of sustainable smart cities

Enabling Technologies for Sustainable Smart City: Recent advances in communication technologies, Enabling technologies for sustainable smart cities- IoT, AI, ML, DL, Big data and data analytics, Blockchain, Cyber-physical systems, Wireless sensor networks

Smart Healthcare in Sustainable Smart Cities: Smart and connected healthcare system, Internet of Medical Things (IoMT), Smart healthcare Services and applications, Smart Healthcare in Sustainable Smart Cities

UNIT-II	9 Hrs

Introduction to Embedded Systems: Definition, Embedded systems vs General computing systems, Classification of Embedded systems, Purpose of Embedded systems, Characteristics & quality attributes of Embedded Systems – Objectives, Phases & approaches of Embedded product Development Life Cycle (EDLC), Embedded system model

Typical Embedded System: System components of typical Embedded system, Processor, Memory & communication interfaces, Washing machine example

UNIT-III	9 Hrs

Embedded Firmware: Embedded firmware design approaches, Embedded firmware development languages, Basic programming in Embedded C

Integration of Hardware and Firmware: Out of circuit programming, In-system programming, In application programming

UNIT-IV	9 Hrs

Device drivers: Device drivers for interrupt handling, Memory device drivers, On-board bus device drivers, I/O device drivers, Memory and I/O device driver interfaces

Hardware Software Co-Design and Program Modelling: Fundamental issues in hardware software co-design, Computational models in Embedded design

Development Environment: Integrated Development Environment (IDE), Cross-compilers, Simulators, Emulators, Debugging

Textbook(s):

1. Priyanka Mishra and Ghanshyam Singh, *Sustainable, Smart Cities Enabling Technologies, Energy Trends and Potential Applications,* Switzerland, Springer Nature, *2023. (chapters 1,3,5,6,9)*
2. K.V. Shibu, *Introduction to Embedded Systems*, 2nd edition. New Delhi: McGraw Hill Education India Private Limited, 2017. *(Chapters 1,2,9,12,15)*

Reference Book(s):

1. Frank Vahid, Tony D. Givargis, *Embedded system Design: A Unified Hardware/Software Introduction,* New Delhi: Wily India Pvt. Ltd., 2006.
2. Raj Kamal, *Embedded Systems: Architecture, Programming and Design*, 2nd ed. New Delhi: Tata McGraw Hill Education India Private Limited, 2008.
3. Michael J. Pont, *Embedded C*, 2nd ed. New Delhi: Pearson Education, 2008.
4. David E. Simon, *An Embedded Software Primer*, New Delhi: Pearson Education Publication, 2002.

Web and Video link(s):

1. https://nptel.ac.in/courses/106105166; *NPTEL Video Lecture on Introduction to Internet of Things by Prof. Sudip Misra, Professor of CSE, IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc24_cs34; *NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things, by Prof. Sudip Misra, Professor of CSE, IIT Kharagpur*
3. https://onlinecourses.nptel.ac.in/noc26_cs22; *NPTEL Video Lecture on Introduction to Embedded System Design, By Prof. Dhananjay V. Gadre, Professor of ECE, Netaji Subhas University of Technology and Prof. Badri Subudhi, Professor of ECE, IIT Jammu*

Course Articulation Matrix (CAM):				**U24OE501D-SD: Sustainable Embedded Solutions for Smart Cities and Healthcare**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE501D-SD.1**	2	1	2	1	1	3	2	2	2	1	2	2	1
CO2	**U24OE501D-SD.2**	2	1	2	1	1	3	2	2	2	1	2	2	1
CO3	**U24OE501D-SD.3**	2	1	2	1	2	3	2	2	2	1	2	2	1
CO4	**U24OE501D-SD.4**	2	1	2	1	1	3	2	2	2	1	2	2	1
U24OE501D-SD		**2**	**1**	**2**	**1**	**1.25**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	make use of enabling technologies for sustainable smart cities and smart healthcare systems	SDG3	Good Health and Well-being	make use of enabling technologies such as IoT, AIML, Big data, CPS, and WSN, which support smart infrastructure, efficient urban services, and improved quality of life, analyze sustainable smart cities and smart healthcare systems with their components, requirements, performance indicators.
CO2	develop embedded system model using the steps of embedded system development life cycle	SDG4	Quality Education	develop embedded firmware using Embedded C provides hands-on programming experience and strengthens core engineering competencies, thereby promoting quality technical education and skill development essential for lifelong learning and professional growth.
CO3	develop embedded firmware using embedded 'C' programming	SDG11	Sustainable Cities and Communities	Implement real-time control and monitoring systems for embedded applications. This supports the development of efficient and reliable electronic systems used in automation, communication, automotive, and IoT domains.
CO4	analyze hardware software co-design principles & program modelling techniques in embedded system design	SDG9	Industry, Innovation and Infrastructure	Enable optimized system development by balancing hardware efficiency and software flexibility. This improves performance, reduces cost, and enhances reliability in embedded applications such as IoT, automotive systems, and industrial automation.

WEB PROGRAMMING

Class: B. Tech. V–Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI502**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After Learning this course students should be able to,

CO1 : apply HTML and CSS techniques to develop responsive and well-structured static web pages with appropriate styling and form controls

CO2 : construct server-side dynamic web pages using JSP and manage data persistence with JDBC

CO3 : develop client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts

CO4 : apply ReactJS concepts and WordPress CMS to develop interactive web applications and basic websites

UNIT-I	9 Hrs

HTML: Document structure, Basic tags, Creating headings, Working with links, Creating paragraph, Working with images, Tables, Frames, Introduction to forms and controls - Creating HTML form, Specifying action URL and method to send the form, Using HTML controls

CSS: CSS (Cascading style sheet) rules and properties, Types -Inline, External and internal style sheets, Style classes, Multiple styles

UNIT-II	9 Hrs

JSP: Syntax and semantics, JSP development model, Components of JSP page - Directives, Comments, Expressions, Scriptlets, Declarations, Implicit objects, Standard actions, Tag extensions, A complete JSP example, Session management - Session tracking, Session API, Application event listeners

JDBC: Database access with JDBC, Overview, JDBC drivers, Connecting to database with driver manager, Statement interfaces - Statement, Prepared statement

UNIT-III	9 Hrs

JavaScript: Declaring variables - The const keyword, The let keyword, Usage of variables, Working with operators, Control flow statements, Template strings, Creating functions - Function declarations, Function expressions, Default parameters, Arrow functions, Objects and Arrays -Destructuring objects, Destructuring arrays, Object literal enhancement, The spread operator, Asynchronous JavaScript - Simple promises with fetch, Async/Await, Building promises classes, ES6 Modules

UNIT-IV	9 Hrs

Fundamentals of React: Hello React, Requirements, Setting up a React project, Meet the React, Component, React JSX, Lists in React, React component instantiation, React DOM, Handler function in JSX, Callback handlers in JSX, React controlled components, Styling in

React - CSS in React

WordPress: Introduction to CMS, Introduction to WordPress, WordPress installation, Dashboard, Themes, Plugins, Pages and posts, Menus, Basic website development

Textbook(s):

1. Kogent, *Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, Dreamtech Press (Black Book), 1st edition, 2013, New Delhi. *(Chapters 2 to 8, 12 to 13)*
2. A. Banks and E. Porcello, *Learning React: Modern Patterns for Developing React Apps*, Greyscale Indian Edition, O'Reilly Media, 2nd edition, New Delhi, 2020. *(Chapters 3 to 4)*
3. R. Weiruch, *The Road to React*, Leanpub Press, 1st edition, 2020. *(Chapters 1 to 3)*

Reference Book(s):

1. U. K. Roy, *Web Technologies*, Oxford Higher Education, 7th edition, 2010, New Delhi.
2. N. Biswas, *Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS*, AVA Publisher, 1st edition, 2021.
3. Matthew MacDonald, *WordPress: The Missing Manual*, O'Reilly Media, 3rd edition, 2023, Sebastopol, California, USA.

Web and Video link(s):

https://onlinecourses.swayam2.ac.in/aic20_sp15/preview*NPTEL Video Lecture on Joomla CMS By Prof Kannan Moudgalya - Principal Investigator of Spoken Tutorial Project | Indian Institute of Technology Bombay.*

Course Articulation Matrix (CAM):				**U24AI502 : WEB PROGRAMMING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI502.1**	3	2	2	2	3	1	-	-	-	1	1	3	3
CO2	**U24AI502.2**	2	2	3	2	3	1	-	-	-	1	1	3	2
CO3	**U24AI502.3**	2	3	3	2	3	1	-	-	-	1	1	3	2
CO4	**U24AI502.4**	2	2	2	3	3	1	-	-	-	1	1	3	3
U24AI502		2.25	2.25	2.5	2.25	3	1	-	-	-	1	1	3	2.5
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply HTML and CSS techniques to develop responsive and well-structured static web pages with appropriate styling and form controls	SDG9	Industry, Innovation and Infrastructure	Developing responsive and well-structured web pages strengthens digital infrastructure by enabling accessible, user-friendly, and scalable web applications that support modern digital services and innovation.
CO2	construct server-side dynamic web pages using JSP and manage data persistence with JDBC	SDG9	Industry, Innovation and Infrastructure	Server-side web applications and database connectivity form the backbone of scalable digital systems, supporting secure information management and reliable web-based services.
CO3	develop client-side interactivity using JavaScript including ES6 features and asynchronous programming concepts	SDG9	Industry, Innovation and Infrastructure	Client-side scripting enhances responsive and interactive web applications, improving user experience and enabling efficient digital platforms essential for modern technological infrastructure.
CO4	apply ReactJS concepts and WordPress CMS to develop interactive web applications and basic websites	SDG 8	Intelligent automation, AI startups, innovation ecosystems	Modern frontend frameworks and CMS platforms enable rapid development of professional web applications and business websites, fostering innovation, entrepreneurship, and digital startup ecosystems.

DESIGN AND ANALYSIS OF ALGORITHMS

Class: B. Tech. V – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI503**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : apply divide and conquer strategy for searching and sorting techniques with performance

CO2 : apply 0/1 Knapsack problem, optimal merge pattern and single source shortest path algorithms using greedy method and N-Queen problem, graph colouring problem using backtracking method

CO3 : apply of algorithms using dynamic programming approach to find the shortest path

CO4 : apply and categorize NP-Hard and NP-Complete problems for the classes of P and NP

UNIT-I	9 Hrs

Introduction: Algorithm analysis, Performance analysis, Space complexity and time complexity, Big 'O' notation, Omega notation, Theta notation, Different mathematical approaches for solving time complexity of algorithms

Sets and Disjoint Set Union: Introduction, Union, Find operations

Divide and Conquer: General method, Binary search, Merge sort, Quick sort, Strassen's matrix multiplication

UNIT-II	9 Hrs

Greedy Method: General method, Knapsack problem, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge patterns, Single source shortest paths

Backtracking: General method, N-Queens problem, Sum of subsets, Graph coloring problem

UNIT-III	9 Hrs

Dynamic Programming Concepts: General method, Multistage graphs, All pairs shortest paths, Single source shortest paths

Applications in Optimization Problems: Optimal binary search trees, String editing, 0/1 Knapsack problem, Reliability design problem, Travelling sales person problem

UNIT-IV	9 Hrs

Branch and Bound: General method, Least cost (LC) search, The 15-puzzle problem, Control abstractions for LC search, 0/1 Knapsack problem, Travelling salesperson problem

NP Hard and NP Complete Problems: Basic concepts, Nondeterministic algorithms, The classes NP-hard and NP-complete; Cook's theorem; NP-hard graph problems – Clique decision problem, Node cover decision problem, Traveling sales person decision problem

Textbook:

1. E. Horowitz, S. Sahni and S. Rajasekaran, *Fundamentals of Computer Algorithms*, 2nd edition, Hyderabad, 1998 *(Chapters 1 to 8 and 11).*

Reference Book(s):

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, Prentice-Hall of India, 3rd edition, 2010, New Delhi
2. Gajendra Sharma, *Design and Analysis of Algorithms*, Rajput: Khanna Publishing, 4th edition, 2019, India
3. S. Sridhar, *Design and Analysis of Algorithms*, UK: Oxford University Press, 3rd edition, 2015, India

Web and Video link(s):
https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_cs47; *NPTEL* Video Lecture on Design and analysis of algorithms by *Prof. Madhavan Mukund, Director Chennai Mathematical Institute.*

Course Articulation Matrix (CAM):		U24AI503: DESIGN AND ANALYSIS OF ALGORITHMS												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI503.1	3	3	2	2	1	-	-	1	1	1	-	2	1
CO2	U24AI503.2	3	3	3	2	1	-	-	1	1	1	-	2	1
CO3	U24AI503.3	3	3	3	2	1	-	-	1	1	1	-	2	1
CO4	U24AI503.4	2	2	2	2	1	-	-	1	1	1	-	2	1
U24AI503		**2.75**	**2.75**	**2.5**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**2**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO-SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply divide and conquer strategy for searching and sorting techniques with performance	SDG9	Industry, Innovation and Infrastructure	Efficient divide and conquer algorithms improve computational performance in large-scale systems such as databases, search engines, and network infrastructure, enabling scalable and innovative solutions.
CO2	Analyze 0/1 Knapsack problem, optimal merge pattern and single source shortest path algorithms using greedy method and N-Queen problem, graph colouring problem using backtracking method	SDG8	Decent Work and Economic Growth	Optimization and resource allocation problems help improve decision-making in logistics, scheduling, and business operations, supporting productivity and economic growth.
CO3	Design of algorithms using dynamic programming approach to find the shortest path	SDG11	Sustainable Cities and Communities	Dynamic programming techniques are used in route optimization, traffic management, and urban planning systems, contributing to efficient and sustainable city infrastructure.
CO4	Analyze and categorize NP-Hard and NP-Complete problems for the classes of P and NP	SDG4	Quality Education	Understanding computational complexity enhances problem-solving skills and theoretical knowledge, strengthening advanced education and research in computer science.

MACHINE LEARNING

Class: B. Tech. V– Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI504**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply machine learning fundamentals, data preprocessing techniques, and Python libraries for data analytics and visualization

CO2: analyze and implement supervised learning algorithms for regression and classification, including linear models, logistic regression, decision trees, k-NN, Naïve Bayes, and support vector machines

CO3: apply unsupervised learning, clustering, feature engineering, and dimensionality reduction techniques including k-Means, DBSCAN, SOM, PCA, SVD, LDA, GMM, and EM for data analysis and representation learning

CO4: develop and evaluate machine learning models using artificial neural networks, ensemble learning, and reinforcement learning techniques for real-world applications

UNIT-I	9 Hrs

Introduction: Types of human learning, Well-posed learning problem, Types of machine learning, Role of machine learning in artificial intelligence applications

Model preparation: Life cycle of machine learning, Basic types of data in machine learning, Exploring structure of data, Data quality and remediation, Data pre-processing

Modelling and evaluation: Predictive models, Descriptive models, training a model- cross-validation, Bootstrap sampling, lazy vs. eager learner, Model representation and interpretability- Underfitting, Overfitting, Bias – variance trade-off, Evaluating performance of a model- classification, Regression, Clustering, Fine tuning of model, Finite and infinite hypothesis space, PAC learning, VC dimension

UNIT-II	9 Hrs

Supervised learning: Supervised learning for regression and classification

Regression algorithms: Simple linear regression, Multiple linear regression, Polynomial regression model, Logistic regression, Maximum likelihood estimation

Classification algorithms: Naive Bayes classifier, Distance measures, k-Nearest Neighbor (kNN), Decision tree, Support vector machines, Kernel trick

UNIT-III	9 Hrs

Unsupervised learning: Unsupervised vs supervised learning, Application of unsupervised learning, Different types of clustering techniques

Partitioning method: k-means and K-medoids, Hierarchical clustering, Density-based methods – DBSCAN, Self-organizing map, Expectation maximization, Gaussian mixture models

Feature engineering and feature transformation: Feature construction, feature extraction by PCA, SVD, LDA, Feature subset selection – Feature relevancy and redundancy measures, Feature selection process and approaches

UNIT-IV	9 Hrs

Artificial neural network: Biological neuron, Artificial neuron, Activation functions, neural network architecture, perceptron, learning process in ANN, Back propagation

Ensemble learning: Boosting – AdaBoost, Stacking, Bagging - random forests, Different ways to combine classifiers

Reinforcement learning: The learning task, SARSA and Q-Learning, Non-deterministic, rewards and actions, Temporal difference learning, The difference between SARSA and Q-Learning, Uses of reinforcement learning

Textbook(s):

1. Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, *Machine Learning*, Pearson Education, 2019. *(Chapters 1 to 4 and 7 to 10)*
2. Stephen Marsland, Taylor & Francis, *Machine Learning: An Algorithmic Perspective*, CRC, 2009. *(Chapter 11)*

Reference Book(s):

1. Tom M. Mitchell, *Machine Learning*, Indian edition, MGH, 2013.
2. Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 1st edition, 2012.
3. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, 1st edition, 2014.
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences, Neural Networks*, Cambridge University Press, 2009.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc24_cs81/course; NPTEL Video Lecture on Introduction to Machine Learning – IITKGP by *Prof. Sudeshna Sarkar, Professor of CSE, IIT Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc24_cs101/course; NPTEL Video Lecture on Introduction to Machine Learning by *Prof. Balaraman Ravindran, Professor of CSE, IIT Madras and Mindtree Faculty Fellow.*

Course Articulation Matrix (CAM):				U24AI504: MACHINE LEARNING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI504.1	2	2	2	1	-	1	-	1	1	1	-	2	2
CO2	U24AI504.2	2	2	1	2	2	-	-	1	1	1	-	2	2
CO3	U24AI504.3	2	2	1	2	2	-	-	1	1	1	-	2	2
CO4	U24AI504.4	-	2	2	3	2	-	1	1	1	1	1	2	2
U24AI504		2	2	1.5	2	2	1	1	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply machine learning fundamentals, data preprocessing techniques, and Python libraries for data analytics and visualization	SDG4	Quality Education	Machine learning fundamentals and Python-based analytics tools improve digital literacy, computational thinking, and modern technical education
CO2	Analyze and implement supervised learning algorithms for regression and classification, including linear models, logistic regression, decision trees, k-NN, Naïve Bayes, and support vector machines	SDG9	Industry, Innovation and Infrastructure	Supervised learning algorithms enable intelligent automation, predictive analytics, and data-driven industrial applications that support innovation and infrastructure development
CO3	Apply unsupervised learning, clustering, feature engineering, and dimensionality reduction techniques including k-Means, DBSCAN, SOM, PCA, SVD, LDA, GMM, and EM for data analysis and representation learning	SDG8	Decent Work and Economic Growth	Clustering, representation learning, and feature engineering techniques support business analytics, intelligent automation, market analysis, and efficient utilization of data resources for productivity enhancement and economic growth
CO4	Develop and evaluate machine learning models using artificial neural networks, ensemble learning, and reinforcement learning techniques for real-world applications	SDG11	Sustainable Cities and Communities	Advanced machine learning models are used in smart city applications such as intelligent transportation, autonomous systems, energy optimization, and sustainable urban planning

UNIVERSAL HUMAN VALUES - II

Class: B. Tech. V– Semester		Branch: Common to All branches	
Course Code:	**U24IK506B**	**Credits:**	**2**
Hours/Week (L-T-P- E):	**2-0-0-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: describe harmony within the individual by understanding the distinct roles of the self and the body

CO2 : analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society

CO3: explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfilment among all orders of nature

CO4: apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being

UNIT-I	6 Hrs

Course Introduction: Need, Basic guidelines, Content and Process for value education **Self-exploration**: 'Natural acceptance' and Experiential validation, Basic human aspirations, Right understanding, Relationship and Physical facility, Fulfilment of aspirations, Understanding happiness and prosperity, Harmony at various levels
Understanding Harmony in the Human Being: Harmony in myself, Understanding human being, Understanding the harmony of self with the body, Harmony in self; Health; Program for self and health

UNIT-II	6 Hrs

Understanding Harmony in the Family: Harmony in human - Human Relationship, Understanding values in human-human relationship, Meaning of Justice (universal values in relationships), Mutual happiness
Understanding Harmony in the Society: Harmony in the society, Visualizing a universal harmonious order in society- Undivided society, Universal order- from family to world family

UNIT-III	6 Hrs

Understanding Harmony in the Nature: Whole existence as coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Recyclability and Self-regulation in nature
Understanding Harmony in the Existence: Understanding existence as co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence

UNIT-IV	6 Hrs

Professional Ethics: People friendly and eco-friendly production systems, Appropriate technologies and management patterns.
Case Studies: Case studies of typical holistic technologies, Management models and production systems

Textbook:

1. R .R. Gaur, R. Sangal and G. P. Bagaria, *Human Values and Professional Ethics*, New Delhi Excel Books, 2010.

Reference Book(S):

1. A.Nagaraj, *JeevanVidya: Ek Parichaya*, Raipur: Jeevan Vidya Prakashan,

Amarkantak, 2018.
2. A.N. Tripathi, *Human Values*, New Age International Publisher, 3rd edition, New Delhi, 2019.
3. M. Govindrajran, S. Natrajan & V.S. Senthil Kumar, *Engineering Ethics (includes Human Values)*, PHI Learning Pvt. Ltd., 12th edition, Haryana, 2011.
4. Jayshree Suresh, B. S. Raghavan, *Human Values & Professional Ethics*, 4th edition, S. Chand & Co. Ltd., New Delhi, 2012.

<u>Additional Resources:</u>

1. A set of DVDs containing - Video of Teachers" Orientation Program - PPTs of Lectures and Practice Sessions (*Audio-visual material for use in the practice sessions*)

<u>Web and Video link(s):</u>

1. https://fdp-si.aicte-india.org/UHVII.php

Course Articulation Matrix					U24IK506B: Universal Human Values - II								
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24IK506B.1	2	1	-	-	-	1	-	3	-	-	-	1	1
CO2	U24IK506B.2	-	2	-	-	-	3	-	3	2	2	-	-	1
CO3	U24IK506B.3	1	2	-	-	-	2	3	2	-	-	-	1	1
CO4	U24IK506B.4	1	2	-	-	-	3	3	3	2	2	3	2	1
U24IK506B		**1.33**	**1.75**	**-**	**-**	**-**	**2.25**	**3**	**2.75**	**2**	**2**	**3**	**1.33**	**1**

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	describe harmony within the individual by understanding the distinct roles of the self and the body	**SDG 4**	**Quality Education**	Develops self-awareness, values, ethical thinking, and holistic education for responsible citizenship.
CO2	analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society.	**SDG 16**	**Peace, Justice and Strong Institutions**	Promotes justice, mutual respect, harmonious relationships, and peaceful societies.
CO3	explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfillment among all orders of nature.	**SDG 13, SDG 15**	**Climate Action; Life on Land**	Enhances understanding of ecological balance, coexistence, environmental sustainability, and conservation.
CO4	apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being.	**SDG 9, SDG 12**	**Industry, Innovation and Infrastructure; Responsible Consumption and Production**	Encourages ethical professional practices, sustainable technologies, and environmentally responsible production systems.

WEB PROGRAMMING LABORATORY

Class: B. Tech. V–Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI509**	**Credits:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After Learning this course students should be able to,

CO1 : construct static web pages using HTML and CSS by implementing page layouts, forms, hyperlinks, tables, and appropriate styling techniques.

CO2 : develop server-side web applications using JSP and JDBC by implementing database connectivity, session management, and server-side validation

CO3 : develop interactive client-side web applications using modern JavaScript features including ES6 syntax, asynchronous programming, and modular programming concepts

CO4 : develop component-based web applications using ReactJS and create basic websites using the WordPress Content Management System (CMS)

Experiment-1 (UNIT-I)

1. Construct the following static web pages with the following attributes:
    a. Basic tags
    b. Heading tags
    c. List (ordered and un-ordered)
    d. Textbox
    e. Buttons

Experiment-2 (UNIT-I)

1. Develop the following static web pages required for an online book store web site
    a. HOMEPAGE
    b. LOGINPAGE

    DESCRIPTION:

    a. HOME PAGE

    The static home page must contain three frames

    i. *Top frame:* Logo and the college name and links to Home page, Loginpage,Registration page, Catalogue page and Cart page (the description of thesepages will be given below
    ii. *Left frame:* At least four links for navigation, which will display the catalogue of respective links
    For e.g.: When you click the link "CSE" the catalogue for CSE Books should be displayed in the Right frame
    iii. *Right frame:* The pages to the links in the left frame must be loaded here. Initially this page contains description of the website

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart

CSE ECE EEE CIV	Description of website

b. LOGIN PAGE

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart
CSE ECE EEE CIV	Username: [ ] Password: [ ] Submit Reset			

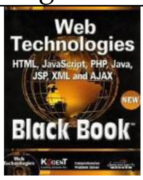
Experiment-3 (UNIT-I)

1. Develop the following static web page required for an online book store web site

CATALOGUE PAGE DESCRIPTION:

The catalogue page should contain the details of all the books available in the web site in a table. The details should contain the following:

- Snap shot of cover page
- Author name and publisher
- Price and add to cart button

Logo	Website Name			
Home	Login	Registration	Catalogue	Cart
CSE ECE EEE CIV		Book: Web Technologies Author: Kogent Publication: Dreamtech Press	$50	Add to Cart
		Book: JSP Complete Reference Author: Phil Hanna Publication: McGraw Hill	$28.5	Add to Cart
		Book: Web Technologies Author: Uttam K. Roy Publication: Oxford Higher Ed	$40	Add to Cart

Experiment-4 (UNIT-I)

Develop a registration form using HTML controls such as name, password, email ID, and phone number. Apply CSS to enhance the appearance of the form by implementing the following features:

1. Apply different fonts and text styles using CSS selectors
2. Set background images for the web page and individual page elements

3. Control image repetition using the background-repeat property
4. Apply styles for hyperlinks
5. Apply inline, internal, and external style sheets
6. Apply CSS classes to style different HTML elements
7. Apply multiple CSS styles to the same HTML element

Experiment-5 (UNIT-II)

1. Develop a JSP program to print current date &time
2. Develop a JSP program to auto refresh a page
3. Develop a JSP program to count no. of visitors on the website
4. Develop a JSP program for error handling
5. Develop a JSP program to demonstrate expression tag
6. Develop a JSP program to detect locale, language settings & local specific time

Experiment-6 (UNIT-II)

1. Develop a JSP page with database connectivity using different JDBC drivers
2. Develop a JSP program to select record from database
3. Develop a JSP program to insert a record into the database
4. Develop a JSP program using the PreparedStatementinterface to execute parameterized queries

Experiment-7 (UNIT-II)

1. Develop a JSP program on implicit object
2. Develop a HTML file to create a simple form with 5 input fields (name, password, email, pin code, phone no. and a submit button) and demonstrate required field validations to validate that all input fields are required and display error messages if the above validations do not hold using JSP
3. Develop a JSP program on session tracking
4. Develop a JSP Program to validate username and password using JDBC

Experiment-8 (UNIT-III)

1. Construct a JavaScript program to validate the fields of the registration form using the following conditions:
   i. Name should contain only alphabets and have a minimum length of 6 characters.
   ii. Password should contain at least 6 characters.
   iii. Email ID should follow the standard format (name@domain.com).
   iv. Phone number should contain exactly 10 digits.
2. Develop a JavaScript program using const, let, and var variables to observe scope and reassignment behavior
3. Construct a JavaScript program that utilizes template strings with dynamic expressions
4. Develop a JavaScript program using a function declaration and invoke the function with appropriate arguments
5. Construct a JavaScript program using a function expression and compare its behavior with a function declaration
6. Build a JavaScript program that demonstrates the use of default parameters in functions

7. Develop a JavaScript program by converting traditional functions into arrow functions with and without parameters
Experiment-9 (UNIT-III)
1. Develop a JavaScript program using object destructuring to extract and display properties from an object 2. Develop a JavaScript program using array destructuring with element skipping to access selected array elements 3. Develop a JavaScript program demonstrating object literal enhancement 4. Develop a JavaScript program using the spread operator to clone and merge objects and arrays 5. Develop a JavaScript program using promises to perform and resolve an asynchronous operation 6. Develop a JavaScript program using the fetch API and promise chaining (.then()) to retrieve and process data from a web resource 7. Develop a JavaScript program using async/await to retrieve and process data from a web resource using the fetch API
Experiment-10 (UNIT-III)
1. Build an ES6 module and import it into another JavaScript file 2. Develop a JavaScript program to export and import variables using ES6 modules 3. Develop a JavaScript program to export and import functions using ES6 modules 4. Develop a simple multi-file JavaScript application using multiple ES6 modules
Experiment-11 (UNIT-IV)
1. Develop a simple hello React application 2. Develop a React project using create React app 3. Develop a React component and render it in an application 4. Develop a React application using JSX to display a dynamic message 5. Develop a React application that displays a list of items using the .map() function 6. Develop a controlled component for handling user input 7. Develop a to-do list application using multiple React components
Experiment-12 (UNIT-IV)
1. Develop a React application using callback functions for button click events 2. Develop React components and apply CSS styling using CSS files and class names 3. Develop a React application for form submission and validation using controlled components 4. Install WordPress on a local server (XAMPP) 5. Create a basic website using pages, posts, and menus 6. Customize the website using themes and plugins 7. Develop a basic portfolio/business website using WordPress CMS
Textbook(s): 1. Kogent, *Web Technologies HTML, CSS, JavaScript, ASP.NET, Servlets, JSP, PHP, ADO.NET, JDBC and XML*, Dreamtech Press (Black Book), 1st edition,2013, New Delhi. (Chapters 2 to 8, 12 to 13). 2. A. Banks and E. Porcello, *Learning React: Modern Patterns for Developing React Apps*, Greyscale Indian Edition, O'Reilly Media, 2nd edition, New Delhi, 2020.(Chapters 3 to 4).

3. R. Weiruch, *The Road to React*, Leanpub Press, 1st edition, 2020. (Chapters 1 to 3).
<u>Reference Book(S):</u> 1. U. K. Roy, *Web Technologies*, Oxford Higher Education, 7th edition, 2010, New Delhi. 2. N. Biswas, *Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS*, AVA Publisher, 1st edition, 2021. 3. Matthew MacDonald, *WordPress: The Missing Manual*, O'Reilly Media, 3rd edition, 2023, Sebastopol, California, USA.
<u>Laboratory Manual</u>: 1. *Web Programming Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW.

Course Articulation Matrix (CAM):				**U24AI509 : WEB PROGRAMMING LABORATORY**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI509.1**	2	2	2	2	2	1	1	1	1	-	2	**2**	**3**
CO2	**U24AI509.2**	2	2	2	2	2	1	1	1	1	-	2	**3**	**3**
CO3	**U24AI509.3**	1	2	2	2	3	1	1	1	1	-	2	**2**	**1**
CO4	**U24AI509.4**	2	2	2	2	3	1	1	1	1	-	2	**1**	**2**
U24AI509		1.75	2	2	2	2.5	1	1	1	1	-	2	2	2.25
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	construct static web pages using HTML and CSS by implementing page layouts, forms, hyperlinks, tables, and appropriate styling techniques	SDG9	Industry, Innovation and Infrastructure	developing structured and user-friendly web pages forms the foundation of scalable digital infrastructure and web-based information systems that support modern digital services
CO2	develop server-side web applications using JSP and JDBC by implementing database connectivity, session management, and server-side validation	SDG9	Industry, Innovation and Infrastructure	server-side web applications and database connectivity provide the backend infrastructure required for secure, scalable, and reliable digital platforms across various application domains
CO3	develop interactive client-side web applications using modern JavaScript features including ES6 syntax, asynchronous programming, and modular programming concepts	SDG9	Industry, Innovation and Infrastructure	modern JavaScript technologies improve responsiveness, modularity, and performance of web applications, contributing to innovative and scalable digital infrastructure
CO4	develop component-based web applications using ReactJS and create basic websites using the WordPress Content	SDG 8	Intelligent automation, AI startups, innovation ecosystems,	reactJS and WordPress enable rapid development of business websites and web applications, supporting innovation, digital entrepreneurship, startup ecosystems, and technology-

	Management System (CMS)		entrepreneurship development.	driven business solutions

DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

Class: B. Tech. V – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI510**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1: apply divide-and-conquer techniques to design and implement efficient algorithms for searching, sorting, and matrix operations.

CO2: develop and analyze greedy and backtracking algorithms for optimization and combinatorial problem-solving.

CO3: apply dynamic programming techniques to solve shortest path and multistage decision-making problems.

CO4: apply branch-and-bound strategies to design optimal solutions for complex combinatorial optimization problems.

Experiment-1 (UNIT-I)

1. An e-commerce platform maintains a sorted list of product IDs {101, 105, 112, 118, 125, 132, 140, 155} to facilitate efficient product retrieval. Develop a program using the divide-and-conquer technique to implement the Binary Search algorithm for locating product ID 125 and display its position if found; otherwise, indicate that the product is unavailable
2. A smart agriculture system records daily temperature readings (°C) from multiple sensors as {34, 29, 41, 27, 36, 32, 45, 31}. Develop a program using the divide-and-conquer technique to determine the minimum and maximum temperature values from the given data

Experiment-2 (UNIT-I)

1. An online retail company maintains a list of customer order values {850, 420, 1250, 640, 980, 310, 720, 1500} for sales analysis. Develop a program using the divide-and-conquer technique to implement the Merge Sort algorithm and arrange the order values in ascending order
2. A logistics company records package delivery times (in minutes) as {45, 22, 68, 15, 37, 54, 29, 61} to evaluate operational efficiency. Develop a program using the divide-and-conquer technique to implement the Quick Sort algorithm and arrange the delivery times in ascending order

Experiment-3 (UNIT-I)

1. A smart city traffic management system analyzes vehicle movement between four major intersections. The traffic flow data from one time interval is represented by matrix **A**, while the traffic influence factors for the next interval are represented by matrix **B**

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \qquad B = \begin{pmatrix} 2 & 1 \\ 4 & 3 \end{pmatrix}$$

Develop a program using the divide-and-conquer technique to implement Strassen's matrix multiplication algorithm and compute the resultant matrix C = A × B

Experiment-4 (UNIT-II)

1. A cargo transportation company has a delivery vehicle with a maximum carrying capacity of **20 kg**. Three high-priority packages are available for shipment, each with an associated profit and weight as shown below:

Package	Profit (₹)	Weight (kg)
P1	25	18
P2	24	15
P3	15	10

Develop a program to apply a greedy strategy to determine the package(s) to be selected for maximizing the total profit without exceeding the vehicle's carrying capacity. Display the selected package(s), total weight, and total profit

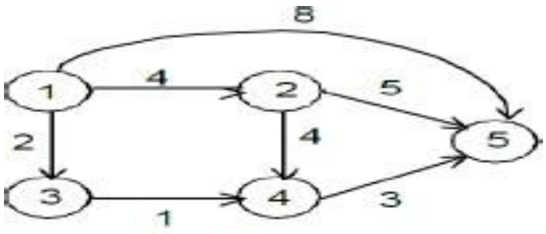
2. A digital marketing agency has received four client campaigns that must be scheduled on a single processing unit. Each campaign requires one unit of time to complete and offers a specific profit if finished on or before its deadline
The profit and deadline details are as follows:

Campaign	Profit (₹)	Deadline (days)
P1	100	2
P2	10	1
P3	15	2
P4	27	1

Develop a program using a greedy scheduling strategy to determine the optimal sequence of campaigns that maximizes the total profit while ensuring that each selected campaign is completed within its deadline. Display the selected sequence of campaigns and the maximum profit obtained

Experiment-5 (UNIT-II)

1. Apply Dijkstra’s algorithm find the shortest path from 1 to each of the other five vertices in the graph



Graph

2. A security agency plans to install surveillance cameras on an (N X N) grid-based high-security facility. To ensure complete coverage and avoid signal interference, no two cameras can be placed in the same row, column, or diagonal

For a facility represented as a 4 × 4 grid, develop a program using the backtracking technique to determine all possible arrangements for placing 4 cameras such that no two cameras interfere with each other. Display all valid configurations and the total number of feasible solutions

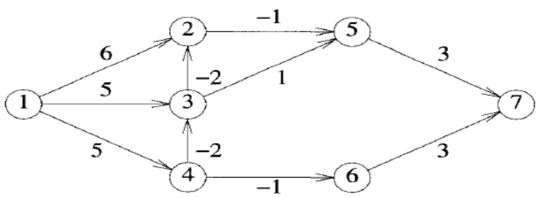
Experiment-6 (UNIT-II)

1. A financial organization is evaluating investment options with amounts {11, 13, 24, 7} (in ₹ lakhs) to achieve a target budget of ₹31 lakhs. Develop a program using the backtracking technique to identify all possible subsets of investment options whose

total amount equals the target budget. Display all valid subsets that satisfy the budget constraint

Experiment-7 (UNIT-II)

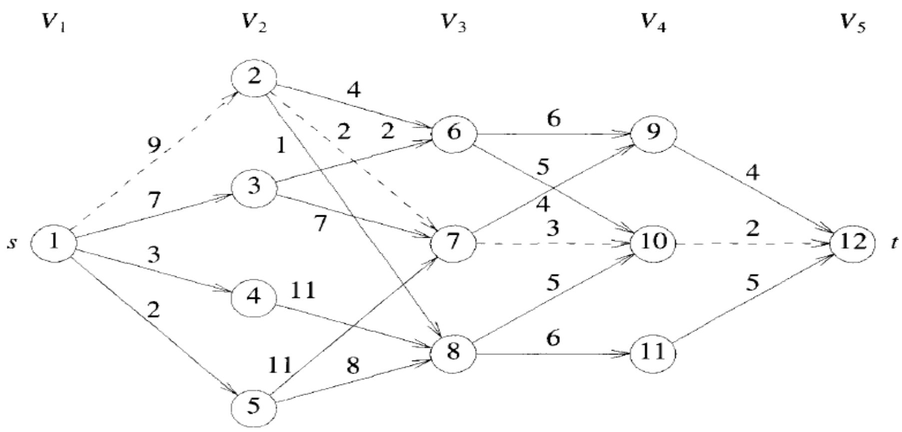
1. A logistics company manages a transportation network represented as a weighted directed graph with 7 nodes numbered 1 to 7, where node 1 is the source distribution center. Some routes may have negative costs due to discounts or incentives. Develop a program using the Bellman–Ford algorithm to determine the shortest path from node 1 to all other nodes. Display the shortest distances and identify any negative weight cycles in the network



(a) A directed graph

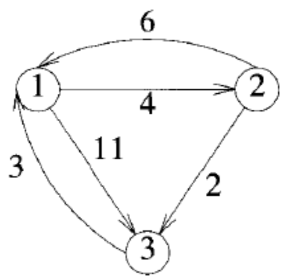
Experiment-8 (UNIT-III)

1. A manufacturing network is represented as a 12-node multistage graph, where node 1 is the source warehouse and node 12 is the destination assembly unit. Intermediate nodes represent processing stages, and edge weights denote transportation costs. Develop a program using the multistage graph algorithm based on dynamic programming to determine the shortest path and minimum cost from node 1 to node 12



Experiment-9 (UNIT-III)

1. Apply A smart city transportation network is represented as a weighted graph with 7 intersections numbered 1 to 7, where edge weights denote travel distances between intersections. Develop a program using the All-Pairs Shortest Paths algorithm based on dynamic programming to determine the shortest paths between every pair of intersections. Display the shortest distance matrix for all node pairs



Experiment-10 (UNIT-III)

1. A compiler design team stores the programming language keywords {do, if, int, while} in a search structure. The successful search frequencies are (p(1:4) = (3, 3, 1, 1)) and the unsuccessful search frequencies are (q(0:4) = (2, 3, 1, 1, 1)). Develop a program using the Optimal Binary Search Tree algorithm based on dynamic programming to construct a tree with minimum expected search cost and display the optimal tree structure

Experiment-11 (UNIT-IV)

1. A logistics company operates delivery services across five cities numbered 1 to 5, where the travel costs between cities are represented as a distance matrix. A delivery vehicle starts from city 1, visits each city exactly once, and returns to the starting city. Develop a program using the Travelling Salesperson Problem algorithm based on dynamic programming to determine the optimal tour with the minimum travel cost. Display the shortest route and the corresponding minimum cost

$$\begin{pmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{pmatrix}$$

Experiment-12 (UNIT-IV)

1. Consider a complete weighted graph representing five cities numbered 1 to 5, where each edge weight denotes the travel cost between two cities. Starting from city 1, develop a program using the Travelling Salesperson Problem (TSP) algorithm based on the branch-and-bound technique to determine the minimum-cost Hamiltonian cycle that visits each city exactly once and returns to the source city. Display the optimal tour and the corresponding minimum travel cost

$$\begin{pmatrix} \infty & 20 & 30 & 10 & 11 \\ 15 & \infty & 16 & 4 & 2 \\ 3 & 5 & \infty & 2 & 4 \\ 19 & 6 & 18 & \infty & 3 \\ 16 & 4 & 7 & 16 & \infty \end{pmatrix}$$

Textbook:

1. E. Horowitz, S. Sahni and S. Rajasekaran, *Fundamentals of Computer Algorithms*, 2nd edition, Hyderabad, 1998 *(Chapters 1 to 8 and 11)*

Reference Book(s):

1. Jon Kleinberg-Eva Tardos, *Algorithm Design*, Boston San Francisco , New York.
2. Mark Allen Weiss, *Data Structures and Algorithm Analysis in Java*, Pearson, 3rd edition, 2012.
3. Kathy Sierra, Bert Bates, *Head First Java*, O'Reilly Publications, 2nd edition, 2020.
4. Narasimha Karumanchi, *Data Structures and Algorithms Made Easy in Java*, CareerMonk.com, 2011.
5. Uttam K. Roy, *Advanced JAVA Programming*, Oxford Publications, 2015.

Laboratory Manual :

1. *Design And Analysis of Algorithms Laboratory Manual,* Department of CSE (AI & ML), KITSW

Course Articulation Matrix (CAM):				**U24AI510: DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI510.1**	3	3	2	2	1	-	1	1	1	-	1	2	1
CO2	**U24AI510.2**	3	3	3	2	1	-	1	1	1	-	1	2	1
CO3	**U24AI510.3**	3	3	3	2	1	-	1	1	1	-	1	2	1
CO4	**U24AI510.4**	2	2	2	2	1	-	1	1	1	-	1	2	1
U24AI510		**1.75**	**2.75**	**2.75**	**2.5**	**1**	**-**	**1**	**1**	**1**	**-**	**2**	**1**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Demonstrate programs on binary search, min-max, merge sort, quick sort and Strassen's matrix multiplication problems	**SDG9**	**Industry, Innovation and Infrastructure**	Efficient algorithms improve computational speed and performance in software systems, enabling scalable solutions in industries such as data processing and scientific computing.
CO2	Develop knapsack, job sequencing with deadline, shortest path using greedy method, N-Queens and sum of subsets using backtracking method	**SDG8**	**Decent Work and Economic Growth**	Optimization and scheduling algorithms support efficient resource allocation, workforce planning, and operational productivity in industries.
CO3	Construct programs on single source shortest path, multistage graph and all pairs shortest path using dynamic programming technique	**SDG11**	**Sustainable Cities and Communities**	Pathfinding and optimization algorithms are applied in transportation systems, traffic management, and urban planning for smarter cities.
CO4	Develop programme for travelling salesperson problem using branch and bound method	**SDG9**	**Industry, Innovation and Infrastructure**	Advanced optimization techniques like branch and bound are used in logistics, supply chain management, and route optimization, improving industrial efficiency and infrastructure.

MACHINE LEARNING LABORATORY

Class: B. Tech. V – Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI511**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: develop data preprocessing pipelines and exploratory data analysis techniques using Python libraries to prepare datasets for machine learning tasks

CO2: develop and evaluate supervised learning models for regression and classification problems using appropriate algorithms and performance metrics

CO3: develop machine learning solutions using unsupervised learning, clustering, feature engineering, and dimensionality reduction techniques for pattern discovery and representation learning

CO4: develop intelligent learning models using artificial neural networks, ensemble learning, and reinforcement learning techniques for real-world applications

Experiment-1 (UNIT-I)

Healthcare analytics: Early diabetes risk analysis

Dataset: Pima Indians diabetes dataset (UCI Repository)

Tasks:

1. Analyze the healthcare dataset to understand its structure and quality
2. Apply data preprocessing and exploratory data analysis using suitable Python libraries.
3. Analyze feature distributions, correlations, and significant risk factors associated with diabetes
4. Interpret the results using appropriate statistical measures and visualizations

Experiment-2 (UNIT-I)

Telecom analytics: Customer churn prediction

Dataset: Iranian churn dataset (UCI Repository)

Tasks

1. Apply preprocessing techniques to customer data
2. Apply train-test split, cross-validation, and bootstrap sampling
3. Compare predictive and descriptive learning approaches
4. Analyze customer churn using suitable learning strategies

Experiment-3 (UNIT-I)

Education analytics: Student academic performance prediction

Dataset: Predict students' dropout and academic success dataset (UCI Repository) or student performance dataset (UCI Repository)

Tasks

1. Develop predictive models for student performance analysis
2. Analyze underfitting, overfitting, and bias–variance tradeoff
3. Compare suitable model evaluation techniques

4. Interpret model performance and learning behaviour

Experiment-4 (UNIT-II)

Real estate analytics: House price prediction
Dataset: California housing dataset (Scikit-Learn)
Tasks
1. Develop simple, multiple, and polynomial regression models
2. Compare regression models for house price prediction
3. Analyze the influence of housing attributes
4. Interpret regression performance using suitable evaluation measures

Experiment-5 (UNIT-II)

Banking Analytics: Credit Risk Assessment
Dataset: Statlog German credit dataset (UCI Repository)
Tasks
1. Develop logistic regression and k-nearest neighbour classifiers
2. Compare distance-based and probability-based classification approaches
3. Analyze customer creditworthiness using classification models
4. Evaluate model performance using suitable measures

Experiment-6 (UNIT-II)

Cybersecurity Analytics: Spam Message Classification
Dataset: SMS spam collection dataset (UCI Repository)
Tasks
1. Develop Naïve Bayes, decision tree, and support vector machine models
2. Compare the performance of different classifiers
3. Analyze the influence of textual features on spam prediction
4. Interpret classification results using suitable evaluation measures

Experiment-7 (UNIT-III)

Retail analytics: Customer segmentation
Dataset: Wholesale customers dataset (UCI Repository)
Tasks
1. Apply k-Means, k-Medoids, and hierarchical clustering techniques for customer segmentation
2. Compare clustering approaches based on cluster quality and customer behaviour
3. Analyze customer groups for business decision-making
4. Evaluate clustering performance using suitable measures

Experiment-8 (UNIT-III)

Cybersecurity analytics: Network intrusion detection
Dataset: NSL-KDD Dataset
Tasks
1. Apply DBSCAN, Gaussian Mixture Models (GMM), Expectation Maximization (EM), and Self-Organizing Maps (SOM) for anomaly detection
2. Compare clustering and representation learning techniques for intrusion detection
3. Analyze anomalous network behaviour and intrusion patterns
4. Evaluate clustering performance using suitable measures

Experiment-9 (UNIT-III)

Image analytics: Handwritten digit recognition
Dataset: MNIST Dataset (OpenML)
Tasks
1. Apply feature extraction and dimensionality reduction techniques including PCA, SVD, LDA, and SOM
2. Analyze feature relevance and class separability
3. Compare feature transformation techniques
4. Evaluate classification performance after feature reduction

Experiment-10 (UNIT-IV)

Healthcare analytics: Breast cancer diagnosis
Dataset: Breast cancer Wisconsin dataset (Scikit-Learn)
Tasks
1. Develop perceptron and artificial neural network models
2. Analyze learning behaviour using backpropagation
3. Compare neural networks with traditional machine learning models
4. Evaluate prediction performance

Experiment-11 (UNIT-IV)

Financial analytics: Income classification
Dataset: Adult income dataset (UCI Repository)
Tasks
1. Develop ensemble learning models for income classification
2. Compare bagging, random forest, adaboost, and stacking techniques
3. Analyze influential features affecting income prediction
4. Evaluate ensemble model performance

Experiment-12 (UNIT-IV)

Smart city analytics: Traffic signal optimization
Dataset: Gymnasium environment
Tasks
1. Develop reinforcement learning agents using SARSA and Q-Learning
2. Analyze temporal difference learning and reward optimization
3. Compare exploration and exploitation strategies
4. Evaluate intelligent traffic control performance

Textbook(s):

1. Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, *Machine Learning*, Pearson Education, 2019. *(Chapters 1 to 4 and 7 to 10)*
2. Stephen Marsland, Taylor & Francis, *Machine Learning: An Algorithmic Perspective*, CRC, 2009. *(Chapter 11)*

Reference Book(s):

1. Tom M. Mitchell, *Machine Learning*, MGH, Indian edition, 2013.
2. Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 1st edition, 2012.
3. Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, 1st edition, 2014.
4. William W Hsieh, *Machine Learning Methods in the Environmental Sciences, Neural*

Networks, Cambridge University Press, 2009.
Laboratory Manual: 1. *Machine Learning Laboratory Manual,* Department of CSE (AI & ML), KITSW.

Course Articulation Matrix (CAM):		**U24AI511: MACHINE LEARNING LABORATORY**											
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI511.1**	2	2	2	1	-	1	-	1	1	1	-	2	2
CO2	**U24AI511.2**	2	2	1	2	2	-	-	1	1	1	-	2	2
CO3	**U24AI511.3**	2	2	1	2	2	-	-	1	1	1	-	2	2
CO4	**U24AI511.4**	-	2	2	3	2	-	1	1	1	1	1	2	2
U24AI511		2	2	1.5	2	2	1	1	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	develop data preprocessing pipelines and exploratory data analysis techniques using Python libraries to prepare datasets for machine learning tasks	SDG4	Quality Education	Data analytics and Python-based preprocessing techniques improve computational thinking, problem-solving ability, and modern technical learning skills
CO2	develop and evaluate supervised learning models for regression and classification problems using appropriate algorithms and performance metrics	SDG9	Industry, Innovation and Infrastructure	Supervised learning models support intelligent automation, predictive analytics, and industrial decision-making systems that enhance innovation and infrastructure development
CO3	develop machine learning solutions using unsupervised learning, clustering, feature engineering, and dimensionality reduction techniques for pattern discovery and representation learning	SDG8	Decent Work and Economic Growth	Clustering and representation learning techniques support business intelligence, intelligent analytics, automation, and efficient utilization of organizational data resources for economic growth
CO4	develop intelligent learning models using artificial neural networks, ensemble learning, and reinforcement learning techniques for real-world applications	SDG11	Sustainable Cities and Communities	Advanced intelligent learning models are widely used in smart city applications including traffic management, autonomous systems, energy optimization, and sustainable urban planning

SEMINAR

Class: B. Tech. V – Semester		Branch: CSE (AI & ML)	
Course Code:	**U24AI512**	**Credits:**	**1**
Hours/Week (L-T-P-E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/ conference proceedings

CO2: demonstrate the skills for performing a literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report

CO3: create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic

CO4: write a "seminar paper" in scientific journal style & format from the prepared seminar report

Student has to give an independent seminar on the state-of-the-art technical topics relevant to their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a Department Seminar Evaluation Committee (DSEC)
2. DSEC shall allot a faculty supervisor to each student for guiding on (i) selection of topic(ii)literature survey and work to be carried out (iii) preparing a report in proper format, and (iv)effective seminar presentation
3. There shall be only Continuous Internal Evaluation (CIE) for seminar
4. The CIE for seminar is as follows:

S.No	Assessment Component	Weightage	CO Mapping	PO Mapping
1	Supervisor Assessment	20	CO2, CO3	PO9, PO10
2	Choice of Base Paper	10	CO1, CO2	PO1, PO2, PO8
3	Seminar Report	30	CO3	PO4, PO5
4	Alignment with SDG's	10	CO3, CO4	PO6, PO7, PO8
5	DSEC Assessment: Oral,Presentation with PPT and Viva-Voce	30	CO3	PO9, PO10

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(a) **Seminar Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest.

(b) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DSEC.*

(c) **Anti-Plagiarism Check:** The seminar report should clear the plagiarism check as per the Anti-Plagiarism (including AI Plagiarism) policy of the institute.

(d) **Presentation:** Each student should prepare a PPT with informative slides and make an effective oral presentation before the *DSEC* as per the schedule notified by the department.

(e) The student has to register for the Seminar as a supplementary examination in the following cases:

i) The student is absent for oral presentation and viva-voce

ii) The student fails to submit the report in prescribed format

iii) The student fails to fulfill the requirements of seminar evaluation as per specified guidelines.

iv) The CoE shall send a list of students registered for supplementary to the HoD concerned

v) The DSEC, duly constituted by the HoD, shall conduct seminar evaluation and send the award list to the CoE within the stipulated time

Seminar Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	20
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
		Communication Skills (5M)	
2	Choice of Base Paper	Reputed Journals (5M)	10
		Base Paper Publication Year (5M)	
3	Seminar Report	Structure, Formatting (5M)	30
		Technical Depth (5M)	
		Case studies / applications (5M)	
		Clarity, Coherence & Writing (5M)	
		Critical Analysis & Insights (5M)	
		References and originality (5M)	
4	Allignment to SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	
5	DESC Assessment	PPT Quality (5M)	30
		Presentation Skills (10)	
		Subject Knowledge (10)	
		Time Management (5)	

Course Articulation Matrix (CAM):		U24AI512: SEMINAR											
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI512.1**	2	2	-	2	2	1	1	-	1	-	3	1	1
CO2	**U24AI512.2**	2	3	1	3	2	1	1	1	2	-	3	1	1
CO3	**U24AI512.3**	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	**U24AI512.4**	1	2	1	2	2	1	2	1	3	-	2	1	1
U24AI512		1.5	2	1	2	2	1.25	1.25	1.33	2.25	1	2.5	1	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/ conference proceedings	**SDG 4**	Quality Education	Identifying and studying emerging ECE technologies such as 6G communications, VLSI, IoT, Artificial Intelligence, Embedded Systems, and Signal Processing promotes self-directed learning, technical competency, and continuous knowledge acquisition.
CO2	demonstrate the skills for performing literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report	**SDG 9**	Industry, Innovation and Infrastructure	Literature review and technical analysis of advanced communication systems, semiconductor technologies, smart electronics, and intelligent networks foster innovation, research culture, and technological infrastructure development.
CO3	create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic	**SDG 11**	Sustainable Cities and Communities	Seminar presentations on smart cities, intelligent transportation systems, IoT-enabled urban services, disaster management systems, and smart communication networks highlight the role of ECE technologies in building sustainable and connected communities.
CO4	write a “seminar paper” in scientific journal style & format from the prepared seminar report	**SDG 12**	Responsible Consumption and Production	Preparation of technical papers promotes ethical dissemination of research findings, proper citation practices, responsible use of information resources, and documentation of sustainable

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				engineering solutions.

Semester -VI Syllabi

VI SEMESTER

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE	U24OE601X - SEB	Open Elective – S&EB(from Pool -XVIII)	2	1	-	3	3
2	PEC	U24AI602	Program Elective –I / MOOCs-I	2	1	-	3	3
3	PCC	U24AI603	Deep Learning	2	1	-	3	3
4	PCC	U24AI604	MLOps	2	1	-	3	3
5	PCC	U24AI605	Big Data Analytics	2	1	-	3	3
6	IKSC	U24IK606B	Essence of Indian Traditional Knowledge	2	-	-	2	2
7	HSMC	U24MH608	Technical English	-	-	2	2	1
8	PCC	U24AI609	Deep Learning Laboratory	-	-	2	2	1
9	PCC	U24AI610	MLOps Laboratory	-	-	2	2	1
10	PCC	U24AI611	Big Data Analytics Laboratory	-	-	2	2	1
11	ELC	U24AI612	Mini Project	-	-	2	2	1
			Total:	12	5	10	27	22
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	5
Total credits for Honours/Minor students:				-	-	-	-	27
Summer/ Inter-semBridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)				NIL				

Pool -XVIII Startups & Entrepreneurship Basket (OE - S&EB)		Program Elective –I	
Course Code	**Course Title**	**Course Code**	**Course Title**
U24OE601A-SEB	Design Thinking	U24AI602A	Computer Vision and Image Processing
U24OE601B-SEB	Innovative Product Design and Development	U24AI602B	Cryptography and Network Security
U24OE601C-SEB	Entrepreneurship	U24AI602C	IoT Architectures and Protocols
U24OE601D-SEB	Design Studio	U24AI602D	Mining Massive Datasets
U24OE601Z-SEB	Any other course approved by BoS Chair and Dean AA	U24AI602E	Human-Computer Interaction

DESIGN THINKING

Class: B. Tech. – VI -Semester		**Branch:** Common to All	
Course Code:	**U24OE601A-SEB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks

CO2 : analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions

CO3 : develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies

CO4 : evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching

UNIT-I	**9 Hrs**

Identify and Analyze Real-world Problems: The Macro Industry View, Problem Identification & Segment Assembly, Customer Identification & Needs Validation, Assess 'Jobs-To-Be-Done' (JTBD) for a Customer Segment, Develop Customer Persona, Validate Customer-Problem fit, Pivot/Refine Customer-Problem fit for feasibility, Examine Ideation Techniques

UNIT-II	**9 Hrs**

Solution Idea Generation & MVP: Opportunity & Competition Mapping, Prototype Development & Minimum Viable Product (MVP), Identify Global Competitors, Review Industry Trends and Estimate Market Size (TAM), Introduction to Financial Planning, Overview of Prototypes & MVP, Build an initial Prototype, Prototypes for Early Validation, Map your Relative Position in the Market, Estimate Opportunity Size

UNIT-III	**9 Hrs**

Market Feasibility & Business Modeling: Lean Canvas Assembly, Marketing & Go-To-Market (GTM) Strategy, Examine Revenue Models, Review and Organize Lean Canvas, Build LC for your Start-up, Build LC for your Start-up, Understand Marketing and Sales, Recommend a GTM Approach, Map a Sales Process, Building an Initial Team

UNIT-IV	**9 Hrs**

Financial Management, Team Scale & Final Pitch: Funding Pathways & Scaling Orientation, Validation & Venture Presentation/Collaboration, Deep Dive into Financial Planning, Analyse the Path to Profitability, Understand Bootstrapping & Funding Options, Finding Co-Founders and Mentors, Thinking Beyond the Prototype - Scale Opportunity & Orientation, Final Milestone - Venture Idea Feasibility Presentation

Textbook:

1. Chandramouli Subramanian & Thiyagarajan p, Sankaran V, *Design Thinking: A Hands-on Approach,* University Press (India) Pvt. Ltd., 1st Edition, 2025, Hyderabad.

Reference Book(s):

1. Andrew Pressman, *Design Thinking: A Guide to Creative Problem Solving for Everyone,* Routledge, Taylor & Francis Group, 7th Edition, 2019, New York.
2. George E. Dieter and Linda C. Schmidt, *Engineering Design,* McGraw-Hill Education, 13th Edition, 2020, New Delhi.

3. Tim Brown, *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation,* HarperBusiness, 7th Edition, 2009, New York.
4. Karl T. Ulrich, Steven D. Eppinger, and Maria C. Yang, *Product Design and Development,* McGraw-Hill Education, 2020, New Delhi.
5. Tom Kelley and David Kelley, *Creative Confidence: Unleashing the Creative Potential Within Us All,* Crown Business, 2013, New York.
6. Idris Mootee, *Design Thinking for Strategic Innovation,* John Wiley & Sons, 1st Edition, 2013, New Jersey.

Web and Video link(s) :

https://nptel.ac.in/courses/110106124; *NPTEL Video Lecture on Design Thinking - A Primer by Prof. Ashwin Mahalingam & Prof. Bala Ramadurai, IIT Madras*.

Course Articulation Matrix (CAM):		**U24OE601A-SEB - Design Thinking**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE601A-SEB.1**	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	**U24OE601A-SEB.2**	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	**U24OE601A-SEB.3**	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	**U24OE601A-SEB.4**	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE601A-SEB		**1.25**	**1.75**	**2.25**	**1.75**	**1.5**	**1.25**	**1**	**1.25**	**1.25**	**1.5**	**1.25**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks	SDG 4	Quality Education	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	Industry, Innovation and Infrastructure	Encourages innovative thinking for solving engineering and societal challenges.
CO2	analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions	SDG 3	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented solutions.
CO3	develop a Lean Canvas for a start-up venture by integrating	SDG 9	Industry, Innovation and	Promotes innovation, product development, and technological

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	value proposition, customer segments, revenue streams, key metrics and growth strategies		Infrastructure	advancement.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization and sustainable product development.
CO4	evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction.

INNOVATIVE PRODUCT DESIGN & DEVELOPMENT

Class: B. Tech.VI -Semester		**Branch:** Common to All	
Course Code:	**U24OE601B-SEB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : Create the systematic lifecycle of engineering design from customer requirements to technical specifications.

CO2 : Choose principles of industrial design, materials science, and ergonomics to optimize product usability.

CO3 : Implement advanced rapid prototyping tools to compress the product development cycle.

CO4 : Design and build prototype performance using structural validation, risk analysis, and engineering metrics.

UNIT-I	**9 Hrs**

Introduction to product design engineering: Translating user needs into Product Design Specifications (PDS), Quality Function Deployment (QFD) and the House of Quality framework, Functional decomposition and physical architecture mapping, Regulatory compliance, Standardsand safety considerations in product architecture

UNIT-II	**9 Hrs**

Principles of Industrial Design (ID): Human-centered design and Ergonomics (Anthropometry), Visual hierarchy, form generationand product aesthetics, Material selection frameworks (structural, thermal, electrical properties) and manufacturing process mapping (DFM/DFA: Design for Manufacturing and Assembly), Design semantics and user-interface touchpoints

UNIT-III	**9 Hrs**

Prototyping strategies: proof-of-concept vs. alpha/beta prototypes: Additive manufacturing (3D Printing: FDM, SLA, SLS) and subtractive techniques (CNC machining), Rapid tooling, Silicone moldingand vacuum forming

Digital prototyping: Computer-Aided Design (CAD) modeling, Assembly verificationand finite element simulations, Virtual and Augmented Reality (VR/AR) workflows for product spatial validation

UNIT-IV	**9 Hrs**

Design of Experiments (DoE) for physical/digital prototypes: Robust design testing and failure analysis, Cost modeling, Bill of Materials (BOM) managementand engineering change orders (ECO)

Sustainable engineering: Design for Environment (DFE) and lifecycle evaluation, Preparing the product blueprint for production scaling and supply chain onboarding

<u>Textbook:</u>

1. Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development*, Tata McGraw-Hill, 10th Edition, 2012, New Delhi.

<u>Reference Book(s):</u>

1. Devdas Shetty, *Product Design for Engineers*, Cengage Learning, 9th Edn, 2015, Boston.
2. A.K. Chitale and R.C. Gupta, *Product Design and Manufacturing,* PHI Learning, 2013, 13th Edn,

New Delhi.
3. Kevin Otto and Kristin Wood, *Product Design: Techniques in Reverse Engineering and New Product Development*, Pearson Education, 2001, New Delhi.
4. Benjamin W. Niebel and Alan B. Draper, *Product Design & Process Engineering*, McGraw-Hill, 1974, New York.
5. Paul Trott, *Innovation Management and New Product Development*, Pearson Education, 2016, Harlow.

Web and Video link(s): .

https://nptel.ac.in/courses/112107217; *NPTEL Video Lecture on Product Design and Development by Prof. Inderdeep Singh, Professor of Mechanical and Industrial Engineering, IIT Roorkee*.

Course Articulation Matrix (CAM):		**U24OE601B-SEB - Innovative Product Design & Development**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE601B-SEB.1**	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	**U24OE601B-SEB.2**	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	**U24OE601B-SEB.3**	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	**U24OE601B-SEB.4**	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE601B-SEB		**1.25**	**1.75**	**2.25**	**1.75**	**1.5**	**1.25**	**1**	**1.25**	**1.25**	**1.5**	**1.25**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	create the systematic lifecycle of engineering design from customer requirements to technical specifications	SDG 4	Quality Education	Promotes creative learning, problem-solving, and innovation skills among students.
		SDG 9	Industry, Innovation and Infrastructure	Encourages innovative thinking for solving engineering and societal challenges.
CO2	choose principles of industrial design, materials science, and ergonomics to optimize product usability	SDG 3	Good Health and Well-being	Human-centered design improves usability, safety, and user well-being.
		SDG 11	Sustainable Cities and Communities	Supports identification of sustainable and community-oriented solutions.
CO3	implement the advanced rapid prototyping tools to compress the product development cycle	SDG 9	Industry, Innovation and Infrastructure	Promotes innovation, product development, and technological advancement.
		SDG 12	Responsible Consumption and	Encourages efficient resource utilization and sustainable product

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
			Production	development.
CO4	design and build prototype performance using structural validation, risk analysis, and engineering metrics	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven business models, and employability skills.
		SDG 9	Industry, Innovation and Infrastructure	Encourages development of practical and scalable engineering solutions.
		SDG 17	Partnerships for the Goals	Promotesteamwork, interdisciplinary collaboration, and stakeholder interaction.

ENTREPRENEURSHIP

Class: B. Tech.VI -Semester		**Branch:** Common to All	
Course Code:	**U24OE601C-SEB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility

CO2 : analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques

CO3 : create students with practical knowledge of business modeling, unit economics, and venture monetization

CO4 : build a clear roadmap for executing, legally safeguarding, and pitching a new venture

UNIT-I	9 Hrs

Introduction to Entrepreneurship: Definitions, Characteristicsand the evolution of an entrepreneurial ecosystem, Myths vs. Realities of starting up, Types of entrepreneurship (Social, Tech, Lifestyle, and Corporate)

Developing an entrepreneurial mindset: Risk-taking, Resilience, Self-efficacyand dealing with failure, Identifying personal strengths and alignment with venture archetypes

UNIT-II	9 Hrs

Deep-dive Problem Identification: Moving from generic ideas to systemic problems, Root-cause analysis, Stakeholder mappingand ecosystem friction points

Customer Discovery methodology: Conducting ethnographic interviews, Building user personas and mapping customer archetypes, Validating market pain points vs. "nice-to-have" solutions, Value Proposition Canvas framework

UNIT-III	9 Hrs

Designing the business architecture: Introduction to the Lean Canvas and Business Model Canvas (BMC), Revenue streams, Pricing strategiesand cost structures

Fundamentals of Unit Economics: Customer Acquisition Cost (CAC), Lifetime Value (LTV)and break-even analysis, Competitor analysis and establishing a Sustainable Competitive Advantage (Moat), Basics of bootstrapping vs. external funding

UNIT-IV	9 Hrs

Building the Go-To-Market (GTM) strategy: Marketing channels, Sales funnelsand early user acquisition, Basics of business registration, Legal structures (LLP, Pvt Ltd) and intellectual property (IP) awareness, Building an early founding team, Equity splitting modelsand culture, Final capstone venture pitch preparation, structuring an investor pitch deck

Textbook:

1. Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, *Entrepreneurship,* McGraw-Hill Education, 1st Edition, 2020, New Delhi.

Reference Book(s):

1. Poornima M. Charantimath, *Entrepreneurship Development and Small Business Enterprises,* Pearson Education, 5th Edition, 2018, New Delhi.
2. Bruce R. Barringer and R. Duane Ireland, *Entrepreneurship: Successfully Launching New Ventures,*

Pearson, 4th Edition, 2019, New Delhi.
3. Eric Ries, *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation*, Crown Business, 2011, New York.
4. S. S. Khanka, *Entrepreneurship Development*, S. Chand & Company, 2010, New Delhi.
5. Peter Thiel, *Zero to One: Notes on Startups, or How to Build the Future*, Crown Business, 2014, New York.

Web and Video link(s): .
https://nptel.ac.in/courses/110105067; *NPTEL Video Lecture on Entrepreneurship Essentials by Prof. Rajeev Roy, Entrepreneurship Development Cell, IIT Kharagpur*.

Course Articulation Matrix (CAM):		**U24OE601C-SEB - Entrepreneurship**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE601C-SEB.1**	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	**U24OE601C-SEB.2**	1	2	2	2	1	1	1	1	1	-	1	1	1
CO3	**U24OE601C-SEB.3**	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	**U24OE601C-SEB.4**	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE601C-SEB		**1.25**	**1.75**	**2.25**	**1.75**	**1.5**	**1.25**	**1**	**1.25**	**1.25**	**1.5**	**1.25**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility	SDG 4	Quality Education	Enhances entrepreneurial learning by fostering creativity, critical thinking, and practical problem-solving skills.
		SDG 9	Industry, Innovation and Infrastructure	Promotes innovation and entrepreneurship by encouraging the development of scalable ventures that contribute to industrial and technological growth.
CO2	analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques	SDG 3	Good Health and Well-being	Facilitates the identification and validation of healthcare-related needs, leading to more user-centric and impactful well-being solutions.
		SDG 11	Sustainable Cities and Communities	Supports the development of community-focused innovations by understanding urban challenges and designing solutions aligned with citizens' needs
CO3	create students with practical knowledge of business modeling, unit economics, and venture monetization	SDG 9	Industry, Innovation and Infrastructure	Strengthens innovation ecosystems by enabling the commercialization and scaling of technology-driven ventures.
		SDG 12	Responsible Consumption	Encourages sustainable business practices by integrating resource efficiency, value

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
			and Production	creation, and responsible production principles into venture planning
CO4	build a clear roadmap for executing, legally safeguarding, and pitching a new venture	SDG 8	Decent Work and Economic Growth	Promotes entrepreneurship and job creation by enabling the successful launch and growth of innovative ventures.
		SDG 9	Industry, Innovation and Infrastructure	Supports innovation-driven enterprises by facilitating the protection, development, and scaling of new technologies and business models
		SDG 17	Partnerships for the Goals	Encourages collaboration with investors, industry partners, mentors, and institutions to strengthen venture growth and impact.

DESIGN STUDIO

Class: B. Tech. VI -Semester		**Branch:** Common to All	
Course Code:	**U24OE601D-SEB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques

CO2 : apply system-level architecture and feasibility models to design technical solutions

CO3 : build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools

CO4 : validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan

UNIT-I	9 Hrs

Foundations of R&D-led entrepreneurship: Identifying deep-tech and high-impact industry problems, Advanced root-cause analysis, Literature review, Patent landscaping and prior art search, Defining the innovation thesis and scientific/technological core, Drafting the initial Product Design Brief

UNIT-II	9 Hrs

Translating insights into technical concepts: Systematic brainstorming and TRIZ (Theory of Inventive Problem Solving) basics, Technology readiness level (TRL) mapping, Engineering/architectural design and system topology, Value proposition design and business-technical feasibility modeling, The "Napkin Pitch" for technical solutions

UNIT-III	9 Hrs

Rapid prototyping paradigms (Software/Hardware/Service): Formulating the Minimum Viable Product (MVP) core feature matrix, Materials selection and Agile development sprints, UI/UX wire framing or hardware schematics, Functional architecture implementation, Risk assessment and failure mode effects analysis (FMEA)

UNIT-IV	9 Hrs

Surface key engineering and market assumptions: Empirical testing protocols, Simulation and data collection, Customer co-creation loops and iterative engineering, Feedback analysis from key industry stakeholders, Creating the product "On-Ramp" strategy (Go-To-Market roadmap, Pilot launch framework, and IP Protection)

Textbook:

1. Brian Sullivan, *The Design Studio Method: Creative Problem Solving with UX Sketching*, Routledge, 2015, New York.

Reference Book(s):

1. Elizabeth Boling, James Benedict Brown, Colin M. Gray, and Derek Jones, *Studio Properties: A Field Guide to Design Education*, Yale Press, 2021, New Haven.
2. Charles Eastman, W. Michael McCracken, and Wendy Newstetter, *Design Knowing and Learning: Cognition in Design Education,* Elsevier, 2001, Oxford.
3. Donald A. Schön, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions,* 17th Edition, Jossey-Bass, 1987, San Francisco.

4. Jerzy Wojtowicz, *Virtual Design Studio*, 8th Edition, Hong Kong University Press, 1995, Hong Kong.
5. Lois Hetland and Ellen Winner, *Studio Thinking: The Real Benefits of Visual Arts Education*, 12th Edition, Teachers College Press, 2007, New York.

Web and Video link(s): .

https://nptel.ac.in/courses/124105003; *NPTEL Video Lecture on Understanding Design by Prof. Prasad Onkar, Department of Design, IIT Hyderabad.*

Course Articulation Matrix (CAM):		**U24OE601D-SEB- Design Studio**												
CO		**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**
CO1	**U24OE601D-SEB.1**	2	2	1	1	1	1	-	1	1	-	1	1	1
CO2	**U24OE601D-SEB.2**	1	2	2	2	1	1	-	1	1	-	1	1	1
CO3	**U24OE601D-SEB.3**	1	2	3	2	2	1	1	1	1	1	1	1	1
CO4	**U24OE601D-SEB.4**	1	1	3	2	2	2	1	2	2	2	2	1	1
U24OE601D-SEB		**1.25**	**1.75**	**2.25**	**1.75**	**1.5**	**1.25**	**1**	**1.25**	**1.25**	**1.5**	**1.25**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**Course Outcome**	**Mapped SDGs**	**SDG Description**	**Justification**
CO1	deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques	SDG 4	Quality Education	Promotes experiential and innovation-based learning by equipping learners with problem-solving, research, and intellectual property skills essential for the 21st century.
		SDG 9	Industry, Innovation and Infrastructure	Fosters innovation capacity by encouraging the development of novel technologies, strengthening industry-oriented research, and supporting sustainable technological advancement.
CO2	apply system-level architecture and feasibility models to design technical solutions	SDG 3	Good Health and Well-being	Supports the design of reliable healthcare technologies and systems that enhance accessibility, efficiency, and overall well-being.
		SDG 11	Sustainable Cities and Communities	Facilitates the creation of smart, resilient, and resource-efficient infrastructure solutions that improve urban sustainability and quality of life.
CO3	build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools	SDG 9	Industry, Innovation and Infrastructure	Promotes technological innovation and strengthens engineering capabilities by accelerating product development and industry-relevant solutions.
		SDG 12	Responsible Consumption and Production	Encourages efficient resource utilization, iterative design, and sustainable product development practices that minimize

CO–SDG Alignment Matrix				
CO	**Course Outcome**	**Mapped SDGs**	**SDG Description**	**Justification**
				waste and optimize production processes.
CO4	validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan	SDG 8	Decent Work and Economic Growth	Supports entrepreneurship, innovation-driven employment, and sustainable economic growth through market-oriented solution development.
		SDG 9	Industry, Innovation and Infrastructure	Strengthens industry-academia innovation ecosystems by facilitating the translation of validated technologies into scalable solutions.
		SDG 17	Partnerships for the Goals	Encourages collaboration among academia, industry, government, and end users to co-create impactful and sustainable innovations.

COMPUTER VISION AND IMAGE PROCESSING

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI602A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the image pre-processing techniques such as sampling, quantization, basic relationships between pixels, various intensity transformation and filtering techniques to enhance the look and feel of an input image for further processing

CO2 : identify the effect of frequency domain filters, image restoration and reconstruction techniques and apply the same for smoothing, sharpening and image enhancement

CO3 : apply morphological image processing techniques on objects present in input images to extract image components and discover various ways to segment the objects present in the input images

CO4 : extract the features to depict the shape of an object and apply classification techniques to identify the object present in an input image

UNIT-I	**9 Hrs**

Introduction: What is digital image processing, Examples of fields that use digital image processing, Fundamental steps in digital image processing

Digital Image Fundamentals: Elements of visual perception, Light and the electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, some basic relationships between pixels, Introduction to the mathematical tools used in digital image processing

Intensity Transformations & Spatial Filtering: The basics of intensity transformations and spatial filtering, Basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods

UNIT-II	**9 Hrs**

Filtering in the Frequency Domain: A brief history of the Fourier series and transform, Preliminary concepts, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, Some properties of the 2-D discrete Fourier transform, The basics of filtering in the frequency domain

Image Restoration and Reconstruction: A model of the image degradation/restoration process, Noise models, Restoration in the presence of noise only-spatial filtering, Periodic noise reduction using frequency domain filtering

UNIT-III	**9 Hrs**

Morphological Image Processing: Preliminaries, Erosion and dilation, Opening and closing, Hit-or-miss transformation, Some basic morphological algorithms

Image Segmentation: Fundamentals, Point, Line and edge detection, Thresholding, Segmentation by region growing and by region splitting and merging, Region segmentation using clustering and superpixels, Segmentation using morphological watersheds

UNIT-IV	9 Hrs

Feature Extraction: Background, Boundary preprocessing, Boundary feature descriptors, Region feature descriptors, Principal components as feature descriptors, Whole-image features, Scale-invariant feature transform

Image Pattern Classification: Background, Patterns and pattern classes, Pattern classification by prototype matching, Optimum (Bayes) statistical classifiers, Neural networks and deep learning, Deep convolution neural networks

Textbook(s):

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, 4th edition, Pearson, 2018, New York. *(Chapters 1 to 3, 9 to 12)*

Reference Book(s):

1. Anil K. Jain, *Fundamentals of Image Processing*, 1st edition, Pearson, 2015, Chennai.
2. B. Chanda, D. Dutta Majunder, *Digital Image Processing and Analysis*, 2nd edition, Prentice Hall of India, 2011, New Delhi.
3. S. Sridhar, *Digital Image Processing*, 2nd edition, Oxford University Press, 2016, Noida.
4. Munesh C. Trivedi, *Digital Image Processing*, 1st edition, Khanna Book Publishing, 2014, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_ee116/preview; *NPTEL Video Lecture on Dital Image Processing by Prof. Prabir Kumar Biaswas, Professor of EEE, IIT Kharagpur.*

Course Articulation Matrix (CAM):				U24AI602A : COMPUTER VISION AND IMAGE PROCESSING									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**U24AI602A.1**	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	**U24AI602A.2**	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	**U24AI602A.3**	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	**U24AI602A.4**	2	2	3	3	-	-	1	-	1	-	2	2	2
U24AI602A		1.75	2	2.25	2	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply image pre-processing techniques	SDG3	Good Health and Well-being	Image pre-processing enhances medical images (MRI, CT, X-ray) by reducing noise and improving contrast, enabling accurate diagnosis and early disease detection.
CO2	Apply frequency domain filtering, restoration and reconstruction techniques	SDG9	Industry, Innovation and Infrastructure	Frequency domain filtering and restoration techniques improve image quality in industrial and satellite imaging systems, supporting reliable infrastructure monitoring and innovation.
CO3	Apply morphological processing and segmentation techniques	SDG11	Sustainable Cities and Communities	Image segmentation and morphological analysis enable applications like traffic analysis, surveillance, and urban monitoring, contributing to safer and smarter cities.
CO4	Apply feature extraction and classification techniques	SDG9	Industry, Innovation and Infrastructure	Feature extraction and classification form the backbone of AI-driven systems such as autonomous vehicles, industrial automation, and smart analytics, fostering technological innovation.

CRYPTOGRAPHY AND NETWORK SECURITY

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI602B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : classify security attacks, services, mechanisms, and symmetric key cryptographic algorithms

CO2 : apply mathematical concepts in cryptographic algorithms for secure communication and key exchange

CO3 : categorize hash functions, message authentication techniques, and key management mechanisms for secure key distribution

CO4 : analyze security issues in application, transport, and network layers for protecting data from unauthorized access and malicious attacks

UNIT-I	9 Hrs

Information and Network Security Concepts: The OSI security architecture, Security attacks, Security services, Security mechanisms

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques

Block Ciphers and the Data Encryption Standard: Traditional block cipher structure, Simplified DES, The data encryption standard, The strength of DES, Block cipher design principles, Block cipher operation

Advanced Encryption Standard: AES structure, AES transformation functions, AES key expansion

UNIT-II	9 Hrs

Introduction to Number Theory: Modular arithmetic, Prime numbers, Fermat's and Euler's theorems, Discrete logarithms

Public-Key Cryptography and RSA: Principles of public-key cryptosystems, The RSA algorithm

Other Public-Key Cryptosystems: Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography

UNIT-III	9 Hrs

Cryptographic Hash Functions: Applications of cryptographic hash functions, Two simple hash functions, Secure hash algorithm (SHA)

Message Authentication Codes: Message authentication requirements, Message authentication functions, Requirements for message authentication codes, Security of MACs, MACs based on Hash functions (HMAC), Digital signatures

Cryptographic Key Management and Distribution: Symmetric key distribution using

symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates	
UNIT-IV	**9 Hrs**
Electronic Mail Security: Internet Mail Architecture, Email formats, Email threats and comprehensive email security, S/MIME **Transport-Level Security:** Web security considerations, Transport layer security **IP Security:** IP security overview, IP security policy, Encapsulating security payload, Combining security associations **Network Endpoint Security:** Firewalls, malicious software	

Textbook(s):

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th edition, Pearson Education, 2023, United Kingdom. *(Chapters 1 to 4, 6 to 7, 9 to 13, 15, 17 to 21)*

Reference Book(s):

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, *Cryptography and Network Security*, 3rd edition, McGraw Hill Education India, 2015, New Delhi.
2. Atul Kahate, *Cryptography and Network Security,* 5th Edition, McGraw Hill Education India, New Delhi, 2026.
3. Dorothy E. Denning, *Cryptography and Data Security*, Addison-Wesley, 1982, United Kingdom.
4. V. K. Jain, *Cryptography and Network Security,* 2013 Edition, Khanna Publishing House, 2013, New Delhi.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs57/preview; *NPTEL Video Lecture on Cryptography and Network Security by Prof. Sourav Mukhopadhya, Department of Mathematics, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI602B: CRYPTOGRAPHY AND NETWORK SECURITY**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI602B.1**	1	-	-	-	-	-	1	1	-	-	-	-	1
CO2	**U24AI602B.2**	2	2	2	1	-	-	-	-	-	-	-	1	2
CO3	**U24AI602B.3**	3	3	2	1	-	1	-	-	-	-	-	1	2
CO4	**U24AI602B.4**	2	2	1	1	-	1	-	-	-	-	-	2	2
U24AI602B		2	2.33	1.67	1	-	1	1	1	-	-	-	1.33	1.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	classify security attacks, services, mechanisms, and symmetric key cryptographic algorithms	SDG9	Industry, Innovation and Infrastructure	Understanding cryptographic algorithms and security mechanisms supports secure digital infrastructure and reliable communication systems for modern industries and innovation.
CO2	apply mathematical concepts in cryptographic algorithms for secure communication and key exchange	SDG9	Industry, Innovation and Infrastructure	Cryptographic algorithms and secure key exchange mechanisms strengthen cybersecurity infrastructure and enable secure digital communication systems.
CO3	categorize hash functions, message authentication techniques, and key management mechanisms for secure key distribution	SDG11	Sustainable Cities and Communities	Secure authentication and key management techniques support safe digital services and secure communication systems used in smart and sustainable communities.
CO4	analyze security issues in application, transport, and network layers for protecting data from unauthorized access and malicious attacks	SDG13	Climate Action	Secure and optimized network protection mechanisms improve reliability and efficiency of digital systems, supporting sustainable and resilient computing infrastructures.

IoT ARCHITECTURES AND PROTOCOLS

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI602C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply IoT network architectures, connectivity technologies, and communication mechanisms to design efficient IoT systems that ensure performance, scalability, and security

CO2 : analyze IoT protocols and constrained network characteristics to evaluate performance, scalability, and reliability in low power and lossy network conditions

CO3: apply IoT data communication and service discovery mechanisms to design efficient device interaction and resource sharing in IoT systems

CO4: analyze IoT infrastructure mechanisms and semantic models to evaluate performance, routing efficiency, and data interoperability in complex IoT environments

UNIT-I	**9 Hrs**

IoT Network Architecture and Design: Drivers behind new network architectures, OneM2M IoT standardized architecture, IoT World Forum (IoTWF) standardized architecture, A Simplified IoT architecture, Core IoT functional stack, IoT data management and compute

IoT Connectivity Technologies: IEEE 802.15.4- 802.15 standards, Architecture, Topology, addressing modes and Packet structure, Security, Zigbee-Overview, Physical layer and Media Access Control (MAC) Layer, Protocol stack, Addressing modes and packet structure, Topology, Security

UNIT-II	**9 Hrs**

IoT Connectivity Technologies: Long Range (LoRa), Physical layer, Media Access Control (MAC) layer and topology, Z-Wave, Thread, ISA100.11A, RFID, NFC, NB-IoT,
Wi-Fi, Bluetooth

IoT Communication Technologies: Constrained nodes, Constrained networks, Types of constrained devices, Low power and lossy networks

UNIT-III	**9 Hrs**

Data Protocols: Message Queue Telemetry Transport (MQTT)-Publish-Subscribe Architecture, Packet structure and communication format; Message Queue Telemetry Transport -Sensor Networks (MQTT-SN)-Architecture, Topology, Constrained Application Protocol (COAP) – Architecture, Message formats, Advanced Message Queuing Protocol (AMQP), Extensible Messaging and Presence Protocol (XMPP), Simple Object Access Protocol (SOAP), Representational State Transfer (REST), WebSocket

Discovery protocols: Physical web, Multicast DNS (mDNS), Universal plug and play

(UPnP)	
UNIT-IV	**9 Hrs**

Infrastructure Protocols: Internet Protocols version6(IPv6), Lightweight On-demand Ad-hoc distance vector Routing protocol – Next Generation (LOADng), Routing Protocols for Low-power (RPL), IPv6 over Low-Power Wireless Personal Area Networks(6LoWPAN), Quick UDP Internet Connections (QUIC), Micro Internet protocols(uIp), Nano Internet Protocols (NanoIP), Content-Centric Networking (CCN)

Semantic Protocols: JavaScript Object Notation for Linked Data (JSON-LD), Web of things model (WoT)

Textbook(s):

1. David Hanes, Ganzalo Salgueiro, Patrick Grossetete Robert Barton, Jerome Henry, *IoT Fundamentals networking Technologies Protocols and use case of Internet of things*, Indian polis Cisco press,2017, Indianapolis. *(Chapter 2)*
2. Sudip Misra, Anandarup Mukherjee, Arljit Roy, *Introduction to IoT*, Cambridge University Press, 2020, New Delhi. *(Chapter 7 and 8)*

Reference Book(s):

1. Jeeva Jose, *Internet of Things*, New Delhi, Khanna, Publishing, 2018.
2. Kamal RAJ, *Internet of Things-Architecture and Design Principles*, New Delhi.
3. Manyur Ramgir, *Internet of Things-Architecture and Implementation and Security,* New Delhi Pearson Education, 2019.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_ee116/preview;*NPTEL Video Lecture on Introduction To Internet Of Things By Prof. Sudip Misra, Professor of EEE, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI602C: IoT ARCHITECTURES AND PROTOCOLS**									
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI602C.1**	2	2	2	1	1	1	1	1	1	1	-	2	2
CO2	**U24AI602C.2**	2	2	2	1	1	1	1	1	1	1	-	2	2
CO3	**U24AI602C.3**	2	2	2	1	1	1	1	1	1	1	-	2	2
CO4	**U24AI602C.4**	2	2	2	1	1	1	1	1	1	1	-	2	2
U24AI602C		2	2	2	1	1	1	1	1	1	1	-	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply IoT network architectures, connectivity technologies, and communication mechanisms to design efficient IoT systems that ensure performance, scalability, and security	SDG9	Industry, Innovation and Infrastructure	Focuses on IoT network architecture and connectivity, which directly supports industrial infrastructure and innovation systems.
CO2	analyze IoT protocols and constrained network characteristics to evaluate performance, scalability, and reliability in low power and lossy network conditions	SDG3	Good Health and Well-being	IoT communication technologies enable healthcare monitoring systems and wearable medical devices.
CO3	apply IoT data communication and service discovery mechanisms to design efficient device interaction and resource sharing in IoT systems	SDG13	Climate Action	Data and discovery protocols are crucial for environmental monitoring and climate data analysis.
CO4	analyze IoT infrastructure mechanisms and semantic models to evaluate performance, routing efficiency, and data interoperability in complex IoT environments	SDG11	Sustainable Cities and Communities	Infrastructure and semantic protocols support smart city applications like traffic, waste, and energy management.

MINING MASSIVE DATASETS

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI602D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply MapReduce and distributed computing techniques to process and manage massive datasets

CO2: develop and implement algorithms for similarity search, streaming data and frequent itemset mining on large-scale datasets

CO3: analyze clustering, link analysis and data mining algorithms for extracting useful information from massive datasets

CO4: develop recommendation systems and web-based data mining applications for intelligent decision-making systems

UNIT-I	9 Hrs

Data Mining-Introduction-Definition of Data Mining-Statistical Limits on Data

Mining, MapReduce and the New Software Stack-Distributed File Systems, MapReduce, Algorithms Using MapReduce

UNIT-II	9 Hrs

Similarity Search: Finding Similar Items-Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Distance Measures

Streaming Data: Mining Data Streams-The Stream Data Model, Sampling Data in a Stream, Filtering Streams

UNIT-III	9 Hrs

Link Analysis- PageRank, Efficient Computation of Page Rank, Link Spam

Frequent Itemsets-Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream

Clustering-The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism

UNIT-IV	9 Hrs

Advertising on the Web-Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation

Recommendation Systems- A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge

Textbook:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, *Mining of Massive Datasets*, Cambridge, University Press, 3rd Edition, 2020, United Kingdom, *(Chapters 1 to 9)*

Reference Book(S): 1. Jiawei Han, Micheline Kamber, *Data Mining Concepts and Techniques*, Morgan Kaufmann Publishers,3rd edition,2016, Singapore. 2. Margaret H Dunham, *Data Mining Introductory and Advanced topics*, PEA.S. Sridhar, *Digital Image Processing*, Oxford University Press, 2nd edition, 2016, Noida.
Web and Video link(s): https://nptel.ac.in/courses/106105174; *NPTEL Video Lecture on Data Mining, IIT Kharagpur Prof. Pabitra Mitra.*

Course Articulation Matrix (CAM):		**U24AI602D: MINING MASSIVE DATASETS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI602D.1**	1	2	2	1	-	-	1	-	1	-	-	2	2
CO2	**U24AI602D.2**	2	2	2	2	-	-	1	-	1	-	2	2	2
CO3	**U24AI602D.3**	2	2	2	2	-	-	1	-	1	-	2	2	2
CO4	**U24AI602D.4**	2	2	3	3	-	-	1	-	1	-	2	2	2
U24AI602D		1.75	2	2.25	2	-	-	1	-	1	-	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply MapReduce and distributed computing techniques to process and manage massive datasets	SDG3	Good Health and Well-being	Processing massive datasets using MapReduce enables efficient analysis of large-scale healthcare data, such as electronic health records, medical imaging datasets, and epidemiological data. This capability supports faster disease pattern identification, large-scale health monitoring, and data-driven decision-making, ultimately contributing to improved healthcare delivery and promoting good health and well-being.
CO2	develop and implement algorithms for similarity search, streaming data and frequent itemset mining on large-scale datasets	SDG9	Industry, Innovation and Infrastructure	The development and implementation of scalable algorithms and data mining methodologies for massive datasets support innovation in data-driven industries. These techniques enable efficient processing, analysis, and

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
				extraction of insights from large-scale data, strengthening digital infrastructure, enhancing industrial applications, and fostering technological advancement, thereby contributing to sustainable industry, innovation, and infrastructure.
CO3	analyze clustering, link analysis and data mining algorithms for extracting useful information from massive datasets	SDG11	Sustainable Cities and Communities	Understanding algorithms for extracting models and insights from large datasets enables the analysis of urban data such as traffic patterns, resource utilization, environmental monitoring, and public services. These data-driven insights support smart city planning, efficient infrastructure management, and improved quality of life, thereby contributing to the development of sustainable cities and communities.
CO4	develop recommendation systems and web-based data mining applications for intelligent decision-making systems	SDG9	Industry, Innovation and Infrastructure	Developing recommendation systems supports innovation in digital platforms by enabling personalized services, efficient resource utilization, and improved user experiences across industries such as e-commerce, healthcare, and smart services. These systems enhance decision-making, optimize operations, and strengthen technological infrastructure, thereby contributing to sustainable industry, innovation, and infrastructure.

HUMAN-COMPUTER INTERACTION

Class: B. Tech. VI–Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI602E**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the principles of graphical and web-based user interface design for effective interaction

CO2 : apply human factors and screen design principles in developing user-oriented interfaces

CO3 : apply menu, navigation, and window design techniques to improve user interaction

CO4 : analyze screen-based controls, graphics, color usage, and usability testing methods for designing effective user interfaces

UNIT-I	9 Hrs

Graphical user interface: Importance of user interface and definition, Benefits of good design, Goals of interface, Popularity of graphics, Advantageous and disadvantageous of graphical system, Characteristics

Web user interface: Popularity, Characteristics and principles of web user interface

User interface design process: Principles of user interface design, Obstacles and pitfalls in the development path, Five-commandments, Usability assessment in design process, Common usability problems

UNIT-II	9 Hrs

Understanding User: Understanding of people interaction with computers, Important human characteristics in design, Human considerations in design

Understand the business functions: Business definition and requirements analysis, Determine basic business functions, Design standard style guides, Training and documentation needs, Understanding the principles of good screen design

UNIT-III	9 Hrs

Menus and navigation schemes: Structures of menus, Functions of menus, Contents of menus, Formatting of menus, Phrasing the menus, Selecting menu choices, Navigating the menus

Selecting the windows: Window characteristics, Components, Window presentation styles, Types of windows, Window management, Organizing window functions, Window operations and web systems, Providing effective feedback and guidance

UNIT-IV	9 Hrs

Screen-based controls: Operable controls, Text entry controls, Selection controls, Other operable controls, Presentation controls

Create meaningful graphics: Icons, Multimedia, Color usages, Choosing colors

Usability testing: Purpose, Importance and scope, Kinds of tests, Developing and

conducting the test
Textbook: 1. Wilbert O Galitz, *The Essential Guide to User Interface Design*,2nd edition,Wiley Dreamtech, 2002,New Delhi
Reference Book(s): 1. Alan Dix, Janet Finlay, Gregory D. Abowd and Russell Beale, *Human Computer Interaction*, 3rd edition, Pearson Education, 2004, New Delhi 2. Jenny Preece, Yvonne Rogers and Helen Sharp, *Interaction Design: Beyond Human–Computer Interaction*, 3rd edition,Wiley Dreamtech, 2007, New Delhi
Web and Video link(s): https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs70;*NPTEL Video Lecture onHuman Computer Interaction, by Prof.Rajiv Ratn Shah, Professor of CSE, IIIT Delhi*

Course Articulation Matrix (CAM):		**U24AI602E: HUMAN-COMPUTER INTERACTION**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI602E.1**	1	2	2	1	1	-	1	-	1	-	1	2	2
CO2	**U24AI602E.2**	1	2	2	2	1	-	1	-	1	-	1	2	2
CO3	**U24AI602E.3**	1	2	2	2	1	-	1	-	1	-	1	2	2
CO4	**U24AI602E.4**	1	2	2	3	1	-	1	-	1	-	1	2	2
U24AI602E		1	2	2	2	1	-	1	-	1	-	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply the principles of graphical and web-based user interface design for effective interaction	SDG9	Industry, Innovation and Infrastructure	Graphical and web-based user interface design promotes innovation and development of efficient, reliable, and accessible digital infrastructure and software systems
CO2	apply human factors and screen design principles in developing user-oriented interfaces	SDG4	Quality Education	Human-centered and user-oriented interface design improves accessibility, inclusiveness, and effectiveness of digital learning and communication systems
CO3	apply menu, navigation, and window design techniques to improve user interaction	SDG11	Sustainable Cities and Communities	Efficient navigation and interaction mechanisms improve accessibility and usability of digital services used in smart and sustainable communities
CO4	analyze screen-based controls, graphics, color usage, and usability testing methods for designing effective user interfaces	SDG3	Good Health and Well-being	Proper usability testing, graphics, and visual interface design improve user comfort, reduce digital fatigue, and support user well-being during human-computer interaction

DEEP LEARNING

Class: B. Tech. VI – Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI603**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : build deep learning models and apply regularization techniques to improve model performance and generalization

CO2 : apply optimization algorithms and develop convolutional neural network models for deep learning applications

CO3 : develop deep learning models using recurrent neural networks and sequence models for sequential data applications

CO4 : apply transfer learning, deep learning models, and hyperparameter optimization to develop and evaluate deep learning solutions

UNIT-I	9 Hrs

Introduction: Why deep learning? Historical trends in deep learning and its performance, Deep feed forward networks, Learning XOR, Gradient based learning, Hidden units, Back propagations and other differentiation algorithms, Case study: Deep learning applications and societal impact

Regularization for Deep Learning: Parameters norm penalties, Norm penalties as constrained optimization, Regularization and under constrained problems, Dataset augmentation, Noise robustness, semi-supervised learning, multitask learning, Early stopping, Parameter tying and sharing, Sparse representations

UNIT-II	9 Hrs

Optimization for Training Deep Models: Pure optimization, Challenges in neural network optimization, Basic optimization algorithms, Algorithms with adaptive learning rates

Convolutional Neural Networks: Convolution operations, Motivation, Pooling, Convolution and pooling as an infinitely strong prior, Variants of the basic convolution functions, Structured outputs, Data types, Efficient convolution algorithms, Random or unsupervised features, Deep convolutional models – LeNet, AlexNet, VGG, GoogleNet (Inception), ResNet

UNIT-III	9 Hrs

Recurrent Neural Networks: Simple RNN, Bidirectional RNN, Deep RNN, Challenges of long-term dependencies, Echo state networks, Long short - term memory , Gated RNNs, Optimization for long term dependencies, Explicit memory

Sequence Models: Encoder- decoder, Sequence to sequence architectures, Representation learning - Auto encoders, Advanced models – Transformer models and Bidirectional encoder representations from transformers (BERT)

UNIT-IV	9 Hrs

Transfer Learning: Concept of transfer learning, Pre-trained models, Fine tuning techniques, Generative adversarial network architecture, variants of GANs, Object detection models - Region based CNN, Fast RCNN – You only look once(YOLO) – Single shot detector

Practical Methodology: Performance metrics, Default baseline models, Debugging strategies, Selecting hyper parameters, Manual hyper parameter tuning, Automatic hyper parameter optimization algorithms- Grid search ,Random search

Textbook(s):

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, 1st edition, MIT Press, 2017 *(Chapters 1 ,6 to 12)*
2. Michael Nielsen, *Neural Networks and Deep Learning*, Determination Press, 1st edition, 2013. *(Chapters 2,3)*

Reference Book(s):

1. Deng & Yu, *Deep Learning: Methods and Applications*, 1st edition, Now Publisher, USA, 2013
2. Antonio Gulli, Amita Kapoor and Sujit Pal, *Deep Learning with TensorFlow 2.0 and Keras*, 2nd edition, Mumbai: Packt, 2019
3. Sebastian Raschka and Vahid Mirjalili - *Python Machine Learning*, 2nd edition, Mumbai: Packt, 2019

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc20_cs62/preview, *NPTEL Video Lecture on Deep Learning by Prof. Prabir Kumar Biaswas, Professor of EEE, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI603 : DEEP LEARNING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI603.1**	2	2	2	1	-	1	-	1	1	1	-	2	2
CO2	**U24AI603.2**	2	2	1	2	2	-	-	1	1	1	-	2	2
CO3	**U24AI603.3**	2	2	1	2	2	-	-	1	1	1	-	2	2
CO4	**U24AI603.4**	-	2	2	3	2	-	1	1	1	1	1	2	2
U24AI603		2	2	1.5	2	2	1	1	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	build deep learning models and apply regularization techniques to improve model performance and generalization	SDG9	Industry, Innovation and Infrastructure	Deep learning fundamentals and optimization techniques enable the development of efficient and scalable AI models, supporting innovation in industrial applications and intelligent systems.
CO2	apply optimization algorithms and develop convolutional neural network models for deep learning applications	SDG3	Good Health and Well-being	CNN-based image recognition is widely used in medical imaging applications such as disease diagnosis and detection, improving healthcare quality and early intervention.
CO3	develop deep learning models using recurrent neural networks and sequence models for sequential data applications	SDG9	Industry, Innovation and Infrastructure	RNN and advanced architectures support applications like speech recognition, predictive analytics, and automation systems, contributing to technological advancement and smart infrastructure.
CO4	apply transfer learning, deep learning models, and hyperparameter optimization to develop and evaluate deep learning solutions	SDG11	Sustainable Cities and Communities	Deep learning applications such as smart surveillance, traffic management, and intelligent communication systems contribute to building safer, efficient, and sustainable urban environments.

MLOPS

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI604**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply MLOps principles, lifecycle management, versioning techniques, and data preprocessing methods to develop production-ready machine learning workflows

CO2: analyze and implement machine learning model development, deployment, containerization, orchestration, and Generative AI concepts for scalable AI applications

CO3: apply monitoring, governance, security, and model maintenance techniques to ensure reliable, secure, and responsible machine learning systems

CO4: demonstrate LLMOps concepts, including prompt engineering and Retrieval-Augmented Generation (RAG), for building and managing modern AI applications

UNIT-I	9 Hrs

Introduction to MLOps: Evolution of MLOps, DevOps vs. MLOps, ML production challenges, ML lifecycle management, Key MLOps features, People of MLOps, MLOps for responsible AI, MLOps for scale, Representation learning: The Core of modern AI

UNIT-II	9 Hrs

Versioning, Pipelines and Data Preprocessing: Data versioning using DVC, Model versioning using MLflow, Pipeline orchestration using Kubeflow, Automated data preprocessing and validation, Experiment tracking

Data Preprocessing for Language Models: Text vectorization layer, Standardization, Vocabulary indexing, Embedding word vectors, TF-IDF, Tokenization fundamentals, Byte pair encoding, Bag of words and Sequential models

UNIT-III	9 Hrs

Model Development and Deployment: Model development, Model training, Model validation, Deployment strategies (Batch, Online and streaming deployment), CI/CD pipelines, Building ML artifacts, Testing pipeline, Containerization using docker, Kubernetes basics for ML deployment, Scaling deployments, Deployment requirements and challenges, Production maintenance

Introduction to Generative AI: Transformer encoder, BERT Models, Decoder-only GPT Models

UNIT-IV	9 Hrs

Monitoring, Governance and LLMOps: Model monitoring, Feedback loop, Logging, Online model evaluation, Model degradation, Ground truth evaluation, Input drift detection, Data drift detection, Model retraining, Governance, Responsible AI, Data governance, Process governance, Governance policies, Governance management, Model risk evaluation, Quality assurance for machine learning, Machine learning security, Adversarial attacks, Model risk mitigation.

Introduction to LLMOps: Prompt engineering, Retrieval-Augmented Generation (RAG).

Textbook(s):

1. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre et al., *Introducing MLOps: How to Scale Machine Learning in the Enterprise*, 1st Edition, O'Reilly Media,

2020. 2. Andriy Burkov, *Machine Learning Engineering*, 1st Edition, True Positive Inc., 2020.
Reference Book(S): 1. Noah Gift, Alfredo Deza, *Practical MLOps*, 1st Edition, O'Reilly Media, 2021. 2. Hannes Hapke, Catherine Nelson, *Building Machine Learning Pipelines*, 1st Edition, O'Reilly Media, 2020. 3. Chris Fregly, Antje Barth, *Data Science on AWS*, 1st Edition, O'Reilly Media, 2021. 4. Yaron Haviv, Noah Gift, *Implementing MLOps in the Enterprise*, 1st Edition, O'Reilly Media, 2023.
Web and Video link(s): https://www.coursera.org/learn/pearson-learn-mlops-for-machine-learning-video-training-xcgjr?utm_source=chatgpt.com

Course Articulation Matrix (CAM):		**U24AI604: MLOPS**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI604.1**	2	2	2	2	2	-	1	-	1	1	2	2	2
CO2	**U24AI604.2**	2	2	3	3	3	-	1	-	1	1	2	3	2
CO3	**U24AI604.3**	2	3	2	2	2	-	1	-	1	1	2	3	3
CO4	**U24AI604.4**	2	2	3	3	3	-	1	-	1	1	2	3	2
U24AI604		**2**	**2.25**	**2.5**	**2.5**	**2.5**		**1**		**1**	**1**	**2**	**2.75**	**2.25**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply MLOps principles, lifecycle management, versioning techniques, and data preprocessing methods to develop production-ready machine learning workflows	SDG9	Industry, Innovation and Infrastructure	MLOps practices such as automation, versioning, and orchestration enhance scalable AI system development, strengthen digital infrastructure, and support innovation.
CO2	analyze and implement machine learning model development, deployment, containerization, orchestration, andGenerative AI concepts for scalable AI applications	SDG9	Industry, Innovation and Infrastructure	Modern deployment technologies and scalable AI platforms contribute to resilient infrastructure, industrial innovation, and efficient deployment of intelligent systems.
CO3	apply monitoring, governance, security, and model maintenance techniques to ensure reliable, secure, and responsible machine learning systems	SDG9	Industry, Innovation and Infrastructure	Advanced AI and LLMOps technologies promote innovation in intelligent systems and enable development of next-generation industrial and digital solutions.
CO4	demonstrate LLMOps concepts, including prompt engineering and Retrieval-Augmented Generation	SDG9	Industry, Innovation and Infrastructure	Governance, ethical AI practices, and reliable monitoring mechanisms support accountable, transparent, and trustworthy AI systems aligned with

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	(RAG), for building and managing modern AI applications			responsible institutional practices.

BIG DATA ANALYTICS

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI605**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the fundamental concepts of big data platforms, analytics, and NoSQL technologies for managing and processing large-scale digital data

CO2 : develop and optimize distributed data processing applications using Apache Hadoop, MapReduce, HDFS, YARN, and MongoDB

CO3 : analyze and implement distributed database and data warehousing solutions using Cassandra and Hive for large-scale data storage and analytics

CO4 : apply Pig and Jasper Reports for big data transformation, analysis, visualization, and reporting applications

UNIT-I	9 Hrs

Introduction to Digital & Big Data: Types of digital data, Classification of digital data, Characteristics of data, Evolution of big data, Definition of big data, Challenges with big data, 3V's of Big data, Non-definitional traits of Big Data - Business intelligence Vs Big Data - Data warehouse and Hadoop environment, Coexistence

Big Data Analytics: Classification of analytics, Data science, Terminologies in big data, CAP Theorem, BASE concept, Few top analytics tools

The Big Data Technology Landscape: NoSQL (Not Only SQL), Hadoop

UNIT-II	9 Hrs

Introduction to Hadoop: History of Hadoop, Hadoop overview, RDBMS vs Hadoop, Distributed computing challenges, Use case of Hadoop, Hadoop distributors, Hadoop distributed file system(HDFS), Processing data with Hadoop, Managing resources and applications with Hadoop YARN (Yet Another Resource Negotiator), Interacting with Hadoop ecosystem

Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting and Compression

MongoDB: Terms used in RDBMS and MongoDB, Data types in MongoDB, MongoDB query language

UNIT-III	9 Hrs

Introduction to Cassandra: Features of Cassandra, CQL data types, CQLSH, Keyspaces, CRUD (Create, Read, Update, and Delete) operations, Collections, Using a counter, Time to live (TTL), Alter commands, Import and export, Querying system tables

Introduction to Hive: Hive architecture, Hive data types, Hive file format, Hive query language (HQL), RCFile implementation, SerDe, User-defined function (UDF)

UNIT-IV	9 Hrs
Introduction to Pig: Pig on Hadoop, Use case for Pig-ETL processing, Data types in Pig, Running Pig, Execution modes of Pig, HDFS commands, Relational operators, Eval function, Complex data types, Piggy bank, User-defined functions (UDF), Parameter substitution, Diagnostic operator, Word count example using Pig, Pig vs Hive **Introduction to Jasper Reports:** Connecting to MongoDB NoSQL database, Connecting to Cassandra NoSQL database **Case Study:** Global innovation network and analysis (GINA)	

Textbook:

1. Seema Acharya and Subhashini Chellappan, *Big Data Analytics*, Wiley India Pvt. Ltd., 2nd edition, 2019, New Delhi. *(Chapters 1 to 11)*

Reference Book(S):

1. John Wiley, *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, EMC Education Services, 1st edition, 2015, United States: Indianapolis.
2. DT Editorial Services, *BIG DATA, Black Book*, DreamTech Press, 1st edition, 2016, New Delhi.
3. Russell Bradberry, Eric Blow, *Practical Cassandra: A Developers Approach*, Pearson Education, 1st edition, 2014, New York.
4. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, *Big Data for Dummies*, John Wiley & Sons, Inc., 1st edition, 2013, New York.
5. Kyle Banker, *MongoDB in Action*, Manning Publications Company, 1st edition, 2012, George Town.
6. Tom White, *Hadoop: The Definitive Guide*, O'Reilly Publications, 4th edition, 2011, New York.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_cs131/preview; *NPTEL Video Lecture on Big Data Computing by Prof. Rajiv Misra, Professor of CSE, IIT Patna.*

Course Articulation Matrix (CAM):				U24AI605: BIG DATA ANALYTICS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**U24AI605.1**	2	2	1	1	-	-	1	1	1	-	1	2	1
CO2	**U24AI605.2**	2	2	2	1	-	-	1	1	1	-	1	2	1
CO3	**U24AI605.3**	2	2	2	2	-	-	1	1	1	-	2	2	1
CO4	**U24AI605.4**	2	2	2	2	-	-	1	1	1	-	2	2	2
U24AI605		2	2	1.75	1.5	-	-	1	1	1	-	1.5	2	1.25
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Apply the fundamental concepts of big data platforms, analytics, and	SDG9	Industry, Innovation and Infrastructure	Big data platforms form the backbone of modern digital infrastructure, enabling scalable data processing and supporting innovation in industries through

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	NoSQL technologies for managing and processing large-scale digital data			efficient data management systems.
CO2	Develop and optimize distributed data processing applications using Apache Hadoop, MapReduce, HDFS, YARN, and MongoDB	SDG8	Decent Work and Economic Growth	Efficient use of big data tools enhances productivity, supports data-driven decision making in enterprises, and contributes to economic growth and employment in IT and data industries.
CO3	Analyze and implement distributed database and data warehousing solutions using Cassandra and Hive for large-scale data storage and analytics	SDG9	Industry, Innovation and Infrastructure	Distributed databases and data warehousing tools enable large-scale analytics, supporting industrial applications such as cloud computing, business intelligence, and big data-driven innovations.
CO4	Apply Pig and Jasper Reports for big data transformation, analysis, visualization, and reporting applications	SDG4	Quality Education	Data analytics tools like Pig and reporting tools like Jasper support knowledge extraction, data visualization, and learning systems, contributing to improved education and informed decision-making.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Class: B.Tech. VI – Semester	**Branch:** VI SEM (CSE, EEE, ECE, ECV)		
Course Code:	**U24IK606B**	**Credits:**	**2**
Hours/Week (L-T-P-E):	**2-0-0-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to…

CO1 : summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga

CO2 : explain Vedas as principal source of knowledge for scientific inventions

CO3 : describe different yogasanas, breathing techniques, chakras, meditation and their benefits

CO4 : discuss the benefits of yoga as an effective tool for management of human crisis

UNIT-I	6 Hrs

Basic Structure of Indian Knowledge System: Introduction, Vedas – origin, Classification, Structure, Rig Veda, Sama Veda, Yajur Veda, Atharva Veda, UpaVedas – DhanurVeda, SthapatVeda, GandharvaVeda, AyurVeda, Vedanga – Shiksha, Chanda, Vyakarna, Nirukta, Kalpa, Jyothisha, Upanga – Dharmashastra, Mimamsa, Tarkashastra, Purana

UNIT-II	6 Hrs

Modern Science and Indian Knowledge System: Introduction, Vedas as basis for modern science, Architectural developments, Medicine and its relevance, Mathematical sciences in Vedas, Space and military related developments, Chemical sciences

UNIT-III	6 Hrs

Yoga and Holistic Health Care: Healthy mind in healthy body, yoga:Definition, types, **Yoga to keep fit:**Diet, Yoga asanas, Fundamentals, Breathing techniques in Patanjali yoga tradition, Pranayama, Chakras, Meditation, Benefits of yoga – Physical health, Emotional health, Prevention of disease, Reducing or alleviating symptoms of problems

UNIT-IV	6 Hrs

Case Studies – Yoga Practice: Yoga as an effective tool for management of human crisis – depression, Self-concept & mental health, Yoga for stress management

Yoga:A way to cure for insomnia

Requisite: Yoga practice sessions are to be conducted for all students taking this course by the time they complete Unit 1 and Unit 2

<u>Textbook(s):</u>

1. Sathish Chandra Chaterjee, Dhirendramohan Datta, *An Introduction to Indian Philosophy*, New Delhi: Rupa Publications Pvt. Ltd. (Chapter 2, 3).
2. Priyadaranjan Ray, S.N. Sen, *The Cultural Heritage of India*, Vol. 6, Science and Technology, Kolkata: The Ramakrishna Mission Institute of Culture.
3. *Yoga Sutra of Patanjali*, Kolkata: Ramakrishna Mission.
4. RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, New Delhi: Vidyanidhi Prakasham, 2016 (Chapter 4, 5, 6, 7, 8).

<u>Reference Book(s):</u>

1. Swami Jitatmananda, *Holistic Science and Vedanta,* Mumbai: Bharatiya Vidya Bhavan (Chapter 2, 3).

Web and Video link(s):
1. NPTEL courses on Indian Philosophy, Yoga and Vedic Sciences available at https://onlinecourses.nptel.ac.in

Course Articulation Matrix (CAM):		**U24IK606B : ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**													
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**U24IK606B.1**	-	-	-	-	-	1	-	2	1	1	-	-	1	1
CO2	**U24IK606B.2**	-	-	-	-	-	1	1	2	1	1	-	-	1	1
CO3	**U24IK606B.3**	-	-	-	-	-	1	-	2	2	1	-	2	1	1
CO4	**U24IK606B.4**	-	-	-	-	-	1	1	2	2	1	-	2	1	1
U24IK606B		**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1.5**	**1**	**-**	**2**	**1**	**1**
		3 – HIGH, 2 – MEDIUM, 1 - LOW													

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga	SDG4	Quality Education	Understanding the foundational structure of Indian knowledge systems supports holistic education, critical thinking, and cultural literacy, contributing to quality and inclusive education.
CO2	explain Vedas as principal source of knowledge for scientific inventions	SDG9	Industry, Innovation and Infrastructure	Recognizing Vedic contributions to science and technology highlights indigenous innovation in areas such as mathematics, architecture and medicine, inspiring modern sustainable technological development.
CO3	describe different yogasanas, breathing techniques, chakras, meditation and their benefits	SDG3	Good Health and Well-being	Knowledge of yoga, pranayama, and meditation directly promotes physical health, mental well-being, and disease prevention, supporting the SDG goal of ensuring healthy lives for all.
CO4	discuss the benefits of yoga as an effective tool for management of human crisis	SDG3	Good Health and Well-being	Understanding yoga as a therapeutic tool for depression, stress, and insomnia contributes to mental health management and holistic wellness, aligning with SDG3 targets on mental health.

TECHNICAL ENGLISH

Class: B. Tech. VI -Semester		**Branch:** Common to All branches	
Course Code:	**U24MH608**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**100**
Total Number of Teaching Hours:	**24 Hrs**	**ESE:**	**-**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to...

CO1 : develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation

CO2 : enhance communication and professional writing skills through podcast comprehension, group discussions, resume and email writing

CO3 : develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports

CO4 : develop the ability to perform well in interviews and present effectively with clarity of speech and appropriate accent

Activity-1	**2 Hrs**

Phonetic Foundations, Authentic Audio-Visual Comprehension & Vocabulary Enhancement: Speech Sounds - Phonemes (Vowels and consonant sounds), Word stress, Syllables - their role and importance in spoken English

Authentic Audio-Visual Comprehension: Movie Clips - Screening of a short native-speaker clip - context comprehension, Focus attention on accent features and key expressions

Vocabulary: Word Formation - Prefixes-Suffixes

Activity: Practice pronunciation through Read-Record-Reflect, Analyze audio-visual content for comprehension and expression usage

Activity-2	**2 Hrs**

Story Narration, Writing Skills and Vocabulary Enhancement - Narrative structure (beginning, build-up, climax, conclusion), Cohesive devices, Voice modulation & Expression

Writing: Principles of Paragraph Writing - Importance of Coherence in Writing- Cause and Effect Paragraphs

Vocabulary: Synonyms and antonyms

Activity: Narrate structured stories with peer interaction, Read-Record-Reflect storytelling activity for pronunciation and expression enhancement, Write a coherent cause and effect paragraph, Vocabulary practice exercises on synonyms and antonyms

Activity-3	**2 Hrs**

Reading Comprehension, Vocabulary Enhancement & Elocution Skills- Reading Comprehension: Main idea identification, Interpretation, Critical analysis

Vocabulary Enhancement: One-word substitutes

Elocution: Speech delivery skills (organization, voice modulation, fluency, pronunciation, and audience engagement)

Activity: Read and analyze passages for comprehension and critical interpretation, Read-Record-Reflect activity for improving reading fluency and pronunciation, Vocabulary exercises on one-word

substitutes and deliver a short speech with emphasis on clarity, Confidence and effective expression	
Activity-4	**2 Hrs**
Think–Pair–Share Conversation (Podcast-Based), **Vocabulary Enhancement:** Introduction to authentic spoken English through podcasts, Listening for gist and specific information and note-taking. Think–Pair–Share strategy, Use of linking words and expressing agreement/disagreement politely **Vocabulary Enhancement**: Idioms in context and usage **Activity**: Listen to podcasts for comprehension and note-making, Think–Pair–Share discussions to exchange ideas and respond confidently, Speak-Record-Reflect activity for improving speaking fluency, Pronunciation and expression	
Activity-5	**2 Hrs**
Group Discussion, Vocabulary Enhancement: GD format and roles, rules of participation, Vocabulary-Word Pairs, Commonly confused words **Activity:** Engage in group discussions focusing on clear expression and interaction and word pair exercises	
Activity-6	**2 Hrs**
Reading Comprehension, Visual Interpretation & Vocabulary Enhancement: Skimming and scanning, Identifying main and supporting ideas, Distinguishing fact and opinion **Visual Interpretation:** Interpreting visual cues, Logical sequence **Vocabulary**: Phrasal Verbs: separable and inseparable forms and contextual usage **Activity:** Engage in reading comprehension tasks for critical analysis, Describe pictures, Speak-Record–Reflect activity for improving fluency, Pronunciation and expression and phrasal verbs practice exercises	
Activity-7	**2 Hrs**
Motivational Speeches, Presentation Skills & Vocabulary Enhancement: Identifying central theme and tone, Note-taking, Narrative techniques **Presentation:** Speak to Inspire- topic selection, Structure (introduction–body–conclusion) V**ocabulary Enhancement**: Collocations-Introduction to collocations, Types of collocations and contextual usage **Activity:** Listen to motivational speeches for comprehension and analysis, Deliver a 3–5-minute inspirational presentation, Speak–Record–Replay activity for improving fluency, Pronunciation and expression and collocations practice exercises	
Activity-8	**2 Hrs**
Writing & Vocabulary Enhancement: Professional Resume Writing techniques, Action verbs in resume writing, Letter of Application, E-mail Etiquette—vocabulary: Jumbled sentences **Activity**: Prepare a professional resume using an appropriate format and action verbs, Write a letter of application and formal e-mail following etiquette and jumbled sentence exercises	
Activity-9	**2 Hrs**
Reading Comprehension, Newspaper Reading & Vocabulary Enhancement: Intensive reading , Extensive reading, Newspaper reading:5W1H method, Summarization, vocabulary building **Activity:** Reading comprehension exercises, Summarizing news content, Discussion of current events, Speak–Record–Replay activity for improving fluency, Pronunciation and expression, Vocabulary building through contextual usage from news articles	
Activity-10	**2 Hrs**
PowerPoint Presentations: Concept and purpose of presentations, Layout and structure (title, introduction–body–conclusion), Slide design elements, Visual aids, Common mistakes to avoid **Activity:** Design and present a poster or PowerPoint presentation on a given topic, Speak–Record–	

Replay activity for improving fluency, Pronunciation and expression, Peer interaction and feedback sessions	
Activity-11	**2 Hrs**
Essay Writing, Vocabulary Enhancement: Concept and Types of Essays**,** Essay structure (introduction–body–conclusion), Paragraph coherence, Clarity and objectivity, Sentence completion with correct word/Group alternative word/group **Activity:** Write essays on given topics focusing on structure, Coherence and clarity, Sentence completion practice exercises	
Activity-12	**2 Hrs**
Mock Interview – Technical & HR: Introduction to mock interviews: Purpose and importance, Types of interviews, Interview etiquette, Self-introduction, Common HR questions, Self-assessment, **Activity:** Mock interview with appropriate dress code, Record and review own performance, Feedback session	

Textbook(s):

1. Arun Sharma & Meenakshi Upadhyay, "*Verbal Ability and Reading Comprehension for CAT & Other Management Examinations*", 8th Edition, McGraw Hill Education (India) Private Ltd, Chennai, 2018.
2. Meenashki Raman & Sangeethe Sharma, "*Technical Communication: Principles and Practice*, 3rd Edition, New Delhi; New York: Oxford University Press,2004.

Reference Book(s):

1. Nishit K. Sinha, "*Verbal Ability and Reading Comprehension for the CAT*", 3rd Edition Pearson India Education Services Pvt. Ltd., Chennai
2. Harper Collins, "*Collins COBUILD English Grammar*" *3rd* Edition, Harper Collins Publishers Ltd.
3. Jerald J. Alfred, Charles T. Brusaw and Walter E. Oliu," *Handbook for Technical Writing*"12th Edition, Macmillan.
4. R.S. Agarwal, "*A modern Approach to Verbal and Non-Verbal Reasoning*" Revised edition 2025 , Chand Publishing, India.

Web and Video link(s): .

1. Learn/Practice English with MOVIES (Lesson #1) Title: The Incredibles https://www.youtube.com/watch?v=5SfQhkMsUFk&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08yXg&inde x=2
2. Learn English with WRECK-IT RALPH https://www.youtube.com/watch?v=wVhG59zh4uQ&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08yXg&ind ex=4
3. The Pursuit of Happiness (2006): Most Powerful Moments https://www.youtube.com/watch?v=TkD1QvjKlqU
4. **Podcast by** Raul John" Inside the Mind of India's AI Kid". Business Today

   https://www.youtube.com/watch?v=biCrIlhZrC4
5. Podcast by Sudha Murthy - So What If I Lost the Battle, I Lived the War | The Ranveer Show https://www.youtube.com/watch?v=KwXtalUuhLc
6. Motivational Talk by Gour Gopal Das, SLEEPLESS Nights for Overnight SUCCESS https://www.youtube.com/watch?v=YyCXp_E4sMU
7. Motivational Talk by Admiral McRaven's Speech for Your Day, "5 Minutes to Start Your Day Right! - MORNING MOTIVATION" https://www.youtube.com/watch?v=b-Pn0yXL9y8

Laboratory Manual:
1. Technical English Manual prepared by the faculty of English, KITSW.

Course Articulation Matrix (CAM):				U24MH608: Technical English										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24MH608.1									2		2	1	1
CO2	U24MH608.2	-	-	-	-	-	-	-	2	2	-	2	1	1
CO3	U24MH608.3	-	-	-	-	-	-	-	-	2	-	2	1	1
CO4	U24MH608.4	-	-	-	-	-	-	-	2	2	-	2	1	1
	U24MH608	-	-	-	-	-	-	-	-	2	-	-	1	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**Course Outcome**	**Mapped SDGs**	**SDG Description**	**Justification**
CO1	develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation.	**SDG 4**	**Quality Education**	This aligns with SDG-4 as it develops effective listening, speaking, reading and writing skills that enable learners to understand native-speakers communication and communicate clearly and fluently with appropriate vocabulary and pronunciation to promote quality education.
CO2	enhance communication and professional writing skills through podcast comprehension, group discussions, resume and Quality Education email writing	**SDG 4, 8**	**Quality Education & Decent work and Economic growth**	This aligns with SDG-4 as it promotes quality education by enhancing employability skills and professional writing skills through podcast comprehension, resume writing, critical reading and group discussion. This aligns with SDG-8 as it helps students expect productive employment and decent work opportunities by fostering academic and creative thinking.

CO–SDG Alignment Matrix				
CO	**Course Outcome**	**Mapped SDGs**	**SDG Description**	**Justification**
CO3	develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports	**SDG 4**	**Quality Education**	This aligns with SDG-4 as it develops the ability to interpret visual information and produce clear and well-structured technical reports for academic and professional contexts
CO4	develop the ability to present effectively with clarity of speech and appropriate accent	**SDG 4**	**Quality Education**	This aligns with SDG-4 as it enhances effective presentation skills and perform well in interviews

DEEP LEARNING LABORATORY

Class: B. Tech. VI – Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI609**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : build deep learning models and apply regularization techniques for effective performance

CO2 : apply adaptive optimization algorithms and develop convolutional neural network models

CO3 : develop deep learning models using recurrent neural networks and sequence models

CO4 : apply transfer learning and hyperparameter optimization techniques to develop and evaluate deep learning models

Experiment-1 (UNIT-I)

1. Develop shallow neural network architectures using Python, TensorFlow, and Keras.
2. Make use of Jupyter notebook/Google Colaboratory to perform tasks such as cloning

GitHub repositories, uploading data, importing datasets from Kaggle, and executing basic file operations. 3. Build a deep feedforward neural network to learn the XOR function using Python and TensorFlow/Keras
Experiment-2 (UNIT-I)
1. Make use of Gradient Descent to train a neural network model and use it to minimize loss on the MNIST dataset. 2. Apply L1 and L2 regularization techniques in a neural network and evaluate their effect on model performance.
Experiment-3 (UNIT-I)
1. Apply early stopping during neural network training and evaluate its impact on overfitting and model generalization. 2. Make use of dataset augmentation techniques and noise injection to train a neural network on the MNIST dataset and evaluate its robustness to noisy inputs
Experiment-4 (UNIT-II)
1. Apply different optimization algorithms (SGD, Momentum) to train a neural network on MNIST and evaluate their convergence behavior. 2. Make use of adaptive optimization algorithms (Adam, RMSProp) to train a neural network and evaluate performance improvements.
Experiment-5 (UNIT-II)
1. Implement and train a CNN model for image classification using both CPU and GPU environments. Compare the training time, inference time, and model performance between CPU and GPU execution using frameworks such as TensorFlow or PyTorch. 2. Make use of pretrained deep convolutional models (AlexNet, VGG, InceptionNet, ResNet) to perform image classification and evaluate their performance.
Experiment-6 (UNIT-II)
1. Apply different learning rates to train a neural network on the MNIST dataset and evaluate their effect on convergence and accuracy. 2. Make use of different variants of gradient descent (Batch Gradient Descent, Stochastic Gradient Descent, and Mini-batch Gradient Descent) to train a neural network on the MNIST dataset and evaluate their impact on convergence speed and model performance.
Experiment-7 (UNIT-III)
1. Build a Simple RNN model to perform sequence prediction on the “Airline Passengers” time-series dataset from Kaggle and evaluate prediction accuracy. 2. Apply Bidirectional and Deep RNN models to perform sentiment classification on a text dataset and evaluate model performance.

Experiment-8 (UNIT-III)
1. Make use of Long Short-Term Memory (LSTM) network to model a time-series dataset and evaluate its ability to capture long-term dependencies. 2. Apply a Gated Recurrent Unit (GRU) model to perform sequence prediction on a time-series dataset and evaluate model performance. 3. Make use of an Encoder–Decoder (Seq2Seq) architecture to perform machine translation on a text dataset and evaluate translation quality.
Experiment-9 (UNIT-III)
1. Develop an auto-encoder model to learn compact feature representations for dimensionality reduction or image reconstruction Tasks: 1. Build and train an autoencoder on a suitable dataset 2. Visualize the latent feature representations 3. Evaluate reconstruction quality using reconstruction loss 4. Compare original and reconstructed outputs 2. Fine-tune a pre-trained Transformer model (e.g., BERT) for a Natural Language Processing task such as sentiment analysis, text classification, or question answering
Experiment-10 (UNIT-IV)
1. Make use of transfer learning with a pretrained CNN architecture such as ResNet , VGG16 to perform image classification on the CIFAR-10 dataset and evaluate performance 2. Make use of You Only Look Once (YOLO) to perform object detection on the PASCAL VOC dataset from Kaggle and evaluate performance using metrics such as Intersection over Union (IoU) and mean Average Precision (mAP).
Experiment-11 (UNIT-IV)
1. Make use of Generative Adversarial Network to generate images from the MNIST dataset and evaluate the quality of generated samples. 2. Apply a variant of GAN (e.g., DCGAN) to generate images and evaluate improvements over the basic GAN model. 3. Apply Grid Search and Random Search techniques to optimize hyperparameters of a neural network model and evaluate performance improvements.
Experiment-12 (UNIT-IV)
1. Develop an end-to-end deep learning solution for a real-world problem such as image classification, object detection, text classification, sentiment analysis, time-series prediction, or speech recognition. The project should include:

- Selection of an appropriate dataset and problem statement.
- Data collection (if required), preprocessing, and visualization.
- Design and implementation of a suitable deep learning model using TensorFlow or PyTorch
- Model training, validation, hyperparameter tuning, and performance evaluation using appropriate metrics
- Performance analysis and comparison with a baseline model or an alternative deep learning approach
- Interpretation of results, documentation of the methodology and findings

Textbook(s):

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, 1st edition, MIT Press, 2017. *(Chapters 1 ,6 to 12)*
2. Michael Nielsen, *Neural Networks and Deep Learning*, Determination Press, 1st edition, 2013. *(Chapters 2, 3)*

Reference Book(s):

1. Deng & Yu, *Deep Learning: Methods and Applications*, 1st edition, Now Publisher, USA, 2013.
2. Antonio Gulli, Amita Kapoor and Sujit Pal, *Deep Learning with TensorFlow 2.0 and Keras*, 2nd edition, Mumbai: Packt, 2019.
3. Sebastian Raschka and Vahid Mirjalili - *Python Machine Learning*, 2nd edition, Mumbai: Packt, 2019.

Laboratory Manual:

1. *Deep Learning Laboratory Manual,* Department of CSE (AI&ML), KITSW

Course Articulation Matrix (CAM):				U24AI609 : DEEP LEARNING LABORATORY									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI609.1	2	2	2	1	-	1	-	1	1	1	-	2	2
CO2	U24AI609.2	2	2	1	2	2	-	-	1	1	1	-	2	2
CO3	U24AI609.3	2	2	1	2	2	-	-	1	1	1	-	2	2
CO4	U24AI609.4	-	2	2	3	2	-	1	1	1	1	1	2	2
U24AI609		2	2	1.5	2	2	1	1	1	1	1	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to*	Relevant SDG	SDG Description	Mapping Justification
CO1	build deep learning models and apply regularization techniques for effective performance	SDG9	Industry, Innovation and Infrastructure	Development and optimization of deep learning models contribute to intelligent systems and innovative technological solutions used in industry and infrastructure

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO2	apply adaptive optimization algorithms and develop convolutional neural network models	SDG9	Industry, Innovation and Infrastructure	Adaptive learning algorithms and CNNs support advanced applications such as computer vision systems used in automation, manufacturing, and smart infrastructure.
CO3	develop deep learning models using recurrent neural networks and sequence models	SDG8	Decent Work and Economic Growth	Predictive analytics using RNN-based models enables data-driven decision-making in business, finance, and industry, improving productivity and economic growth.
CO4	apply transfer learning and hyperparameter optimization techniques to develop and evaluate deep learning models	SDG4	Quality Education	Speech and NLP-based systems enhance accessibility to education through automated translation, speech interfaces, and intelligent learning platforms.

MLOPS LABORATORY

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI610**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : design and implement end-to-end machine learning pipelines for real-world applications using lifecycle management practices including data preparation, training, and deployment.

CO2 : apply versioning and experiment tracking techniques for reproducible ML workflows using tools like MLflow and DVC for efficient model and dataset management.

CO3 : deploy machine learning models using modern tools and frameworks such as Docker and FastAPI to enable scalable deployment across cloud and edge environments.

CO4 : monitor model performance and handle issues like data drift and retraining while ensuring reliability, governance, and ethical practices in production ML systems.

Experiment-1

1. **MLOps Workflow for Hospital Emergency Prediction using ETS Data on AWS**
   Develop and implement a Machine Learning Operations (MLOps) framework for predicting emergent medical situations at the point of patient admission to a hospital. Develop a predictive model to leverage historical patient data, particularly the Emergency Triage Score (ETS) dataset which can be collected from https://www.kaggle.com/datasets/maalona/hospital-triage-and-patient-history-data, to probabilistically anticipate instances where a significant influx of patients is likely to occur.

Experiment-2

1. **Financial Fraud Detection using Deep Learning and MLOps**

   Develop a robust solution for detecting financial fraud using MLOps methodologies analyzing historical transaction data, customer behavior, and relevant factors to identify and prevent fraudulent activities in the financial sector using the Paysim synthetic dataset collected from https://www.kaggle.com/datasets/ealaxi/paysim1 .

Experiment-3

1. **Customer Conversational Intelligence Platform**

   Develop a platform that harnesses the power of machine learning to analyze vast amounts of customer interaction data and to derive actionable insights from these interactions, optimize customer service processes, and enhance overall customer experience. The dataset such as 3K Conversations Dataset for ChatBot, Customer Support on Twitter Dataset can be collected from https://www.kaggle.com/datasets.

Experiment-4
1. **Driver Demand Prediction for Optimal Food Delivery Charges** Predict the demand for delivery drivers in specific regions and times, leveraging MLOps methodologies by analyzing order requests, driver activity, and related parameters to optimize delivery charges, ensuring consistency and minimizing customer drop-offs, forecasting driver demand, thereby streamlining delivery pricing. The Food Delivery Time Prediction dataset collected from https://www.kaggle.com/datasets/bhanupratapbiswas/food-delivery-time-prediction-case-study.
Experiment-5
1. **Personalized Financial Advisor using Large Language Model (LLM)** Develop an Intelligent Financial Advisor powered by a Large Language Model (LLM) to provide personalized financial advice and guidance to individuals by leveraging NLP and machine learning techniques to assist users in making informed financial decisions.
Experiment-6
1. **Automated Search Engine Optimization (SEO) tool** Create an automated Search Engine Optimization (SEO) tool on an AI-based chatbot system using natural language processing (NLP) and machine learning (ML) algorithms to analyze website content, identify SEO issues, and provide recommendations for improvement.
Experiment-7
1. **Automated Answer Validation for Science Question Answering using Siamese Text Similarity Model** Develop an automated answer validation system using a Siamese text similarity model to compare student responses with the correct answer and distractors to determine the level of correctness and provide appropriate feedback thereby streamlining the assessment process, reducing manual effort, and ensuring consistent evaluation, leading to improved learning outcomes in the science domain. The SciQ (Scientific Question Answering) dataset can be collected from https://www.kaggle.com/datasets/thedevastator/sciq-a-dataset-for-science-question-answering .
Experiment-8
1. **GAN based interior designs** Generate realistic new interior room designs by training a GAN network on the IKEA Interior Design Dataset collected from https://www.kaggle.com/datasets/ahmedkallam/ikea-sa-furniture-web-scraping .

Experiment-9

1. **Image-based plant disease identification**

   Build a convolutional neural network or to use transfer learning and develop a plant disease identification tool using Crop Disease Image Dataset collected from https://www.kaggle.com/datasets/jawadali1045/20k-multi-class-crop-disease-images .

Experiment-10

1. **Food Image Segmentation**

   Make a model that can segment the food components present in an input food image and build an application that can predict the food class and the food portions from it. The Food Segmentation Object Detection dataset collected from https://www.kaggle.com/datasets/trainingdatapro/food-segmentation used for implementing the experiment.

Experiment-11

1. **Financial Fraud Detection using Deep Learning and MLOps**

   Develop a robust solution for detecting financial fraud using MLOps methodologies by analyzing historical transaction data, customer behavior, and relevant factors to identify and prevent fraudulent activities in the financial domain.

Experiment-12

1. **Customer Conversational Intelligence Platform**

   Develop a platform that harnesses the power of machine learning to analyze vast amounts of customer interaction data to derive actionable insights from these interactions, optimize customer service processes, and enhance overall customer experience. The dataset such as conversation datasets for chatbot and customer support interactions can be used for developing the Customer Conversational Intelligence Platform.

<u>Textbook(s):</u>

1. Mark Treveil & Alok Shukla, *Introducing MLOps: How to Scale Machine Learning Projects with Continuous Delivery, Monitoring and Automation*, O'Reilly, 2020.
2. Burkov, A, *Machine Learning Engineering*, 2020.

<u>Reference Book(S):</u>

1. Noah Gift & Alfredo Deza, *Practical MLOps*, O'Reilly, 2021.
2. Hannes Hapke & Catherine Nelson, *Building Machine Learning Pipelines*, O'Reilly, 2020.
3. Chris Fregly & Antje Barth, *Data Science on AWS*, O'Reilly, 2021.
4. Haviv, Y. & Gift, N, *Implementing MLOps in the Enterprise*, O'Reilly, 2023.

<u>Laboratory Manual</u>:

1. *MLOPS,* Department of CSE (AI & ML), KITSW

Course Articulation Matrix (CAM):		U24AI610: MLOPS LABORATORY												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI610.1**	2	2	2	1	3	1	1	1	1	-	-	2	2
CO2	**U24AI610.2**	2	2	3	2	3	1	1	1	1	-	2	2	2
CO3	**U24AI610.3**	2	2	3	3	3	1	1	1	1	-	2	3	3
CO4	**U24AI610.4**	2	2	3	3	3	1	1	1	2	-	2	3	3
U24AI610		**2**	**2**	**2.75**	**2.25**	**3**	**1**	**1**	**1**	**1.25**	**-**	**2**	**2.5**	**2.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Design and implement end-to-end machine learning pipelines for real-world applications using lifecycle management practices including data preparation, training, and deployment.	SDG9	Industry, Innovation and Infrastructure	Development of ML pipelines for applications like healthcare prediction and fraud detection supports innovation and strengthens digital infrastructure.
CO2	Apply versioning and experiment tracking techniques for reproducible ML workflows using tools like MLflow and DVC for efficient model and dataset management.	SDG9	Industry, Innovation and Infrastructure	Ensures reproducibility and scalability of ML systems, promoting reliable and efficient industrial AI solutions.
CO3	Deploy machine learning models using modern tools and frameworks such as Docker and FastAPI to enable scalable deployment across cloud and edge environments.	SDG9	Industry, Innovation and Infrastructure	Supports scalable and efficient deployment of ML systems, enhancing industrial automation and infrastructure.
CO4	Monitor model performance and handle issues like data drift and retraining while ensuring reliability, governance, and ethical practices in production ML systems.	SDG8	Decent Work and Economic Growth	Improves productivity and system reliability, contributing to sustainable economic growth and efficient workflows.

BIG DATA ANALYTICS LABORATORY

Class: B. Tech. VI – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI611**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : develop programs to implement Hadoop ecosystem components such as HDFS for distributed data storage and file management

CO2 : develop programs to process and analyze large datasets using MapReduce and manage data using MongoDB for efficient data handling

CO3 : apply distributed database techniques using Cassandra and data warehousing concepts using Hive for storing, querying, and analyzing big data

CO4 : develop programs to perform data transformation and analysis using Pig Latin scripts for processing large datasets

Experiment-1

1. Install Hadoop in single-node mode and perform basic HDFS file operations such as adding, retrieving, and deleting files.

Experiment-2

1. Demonstrate HDFS features by modifying replication factor and analyzing block distribution.

Experiment-3

1. Develop a MapReduce program to implement Word Count on a given dataset.

Experiment-4

1. Develop a MapReduce program to perform sorting and filtering operations on a dataset.

Experiment-5

1. Implement CRUD operations and basic queries using MongoDB.

Experiment-6

1. Implement aggregation functions such as count, sort, limit, skip, and grouping using MongoDB.

Experiment-7

1. Create keyspace and tables in Cassandra and perform CRUD operations using CQL.

Experiment-8

1. Implement advanced Cassandra features such as collections, counters, and TTL.

Experiment-9

1. Use Hive to create databases and tables and perform data loading and querying using HiveQL.

Experiment-10

1. Implement advanced Hive operations such as joins, partitioning, and analytical queries.

Experiment-11

1. Write Pig Latin scripts to perform data transformation operations such as sort, group,

join, project, and filter.
Experiment-12
1. Perform end-to-end data analysis using Hive or Pig on a real dataset and generate meaningful insights.
<u>Textbook(s):</u> 1. Seema Acharya and Subhashini Chellappan, *Big Data Analytics*, Wiley India Pvt. Ltd., 2nd edition, 2019, New Delhi. *(Chapters 1 to 11)*
<u>Reference Book(S):</u> 1. John Wiley, *Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data*, EMC Education Services, 1st edition, 2015, United States: Indianapolis. 2. DT Editorial Services, *BIG DATA, Black Book*, DreamTech Press, 1st edition, 2016, New Delhi. 3. Russell Bradberry, Eric Blow, *Practical Cassandra: A Developers Approach*, Pearson Education, 1st edition, 2014, New York. 4. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, *Big Data for Dummies*, John Wiley & Sons, Inc., 1st edition, 2013, New York. 5. Kyle Banker, *MongoDB in Action*, Manning Publications Company, 1st edition, 2012, George Town. 6. Tom White, *Hadoop: The Definitive Guide*, O'Reilly Publications, 4th edition, 2011, New York.
<u>Laboratory Manual</u>: 1. *Big Data Analytics Laboratory Manual,* Department of CSE (AI & ML), KITSW

Course Articulation Matrix (CAM):				**U24AI611: BIG DATA ANALYTICS LABORATORY**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI611.1**	2	2	2	1	2	-	1	2	1	-	2	3	1
CO2	**U24AI611.2**	2	2	2	1	-	-	1	2	1	-	2	3	1
CO3	**U24AI611.3**	2	2	2	1	2	-	1	2	1	-	2	3	1
CO4	**U24AI611.4**	2	2	2	1	-	-	1	2	1	-	2	3	1
U24AI611		2	2	2	1	2	-	1	2	1	-	2	3	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop programs to implement Hadoop ecosystem components such as HDFS for distributed data storage and file management	SDG9	Industry, Innovation and Infrastructure	Hadoop enables scalable and distributed data infrastructure, forming the backbone of modern data-driven industries and supporting innovation in large-scale data processing systems.
CO2	Develop programs to process and analyze large datasets using MapReduce and manage data using MongoDB	SDG8	Decent Work and Economic Growth	Big data processing and NoSQL databases enhance enterprise productivity, enable data-driven decision making, and contribute to economic growth and job creation in IT sectors.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	Apply distributed database techniques using Cassandra and data warehousing concepts using Hive	SDG9	Industry, Innovation and Infrastructure	Distributed storage and analytics systems like Cassandra and Hive support scalable industrial applications such as cloud computing, big data analytics, and intelligent infrastructure.
CO4	Develop programs to perform data transformation and analysis using Pig Latin scripts	SDG4	Quality Education	Data processing tools like Pig support learning, knowledge discovery, and development of analytical skills, contributing to quality education and skill development.

MINI PROJECT

Class: B. Tech. VI – Semester		**Branch: CSE (AI & ML)**	
Course Code:	**U24AI612**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	**-**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship

CO2: demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

CO3: make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project

CO4: write a "Mini project paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project

Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.

Guidelines:

1. The HoD shall constitute a *Department Mini Project Evaluation Committee (DMPEC)*
2. *DMPEC* shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format and (iv) effective mini project oral presentation
3. There shall be only continuous Internal Evaluation (CIE) for miniproject
4. The CIE for mini project is as follows:

S.No	Assessment Component	Weightage	CO Mapping	PO Mapping
1	Supervisor Assessment	15	CO1, CO2	PO9, PO10
2	Working Model	20	CO2, CO3	PO3, PO5
3	Mini Project Report	15	CO3	PO4, PO5
4	Mini Project Paper	10	CO1, CO4	PO1, PO8
5	Video Pitch	10	CO3, CO4	PO9, PO10
6	Oral Presentation/Viva	20	CO3, CO4	PO9, PO10
7	Alignment with SDGs	10	CO3, CO4	PO6, PO7, PO8
	Total Weightage:	100		

Note: It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(a) **Mini Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest

(b) **Working Model**: Each student is requested to develop a working model / process / system on the chosen work and demonstrate before the *DMPEC* as per the dates specified by *DMPEC*

(c) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DMPEC*

(d) **Anti-Plagiarism Check:** The seminar report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *DMPEC* as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Mini project as supplementary examination in the following cases:

  i) he/she is absent for oral presentation and viva-voce

  ii) he/she fails to submit the report in prescribed format

  iii) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines

  iv) The CoE shall send a list of students registered for supplementary to the HoDconcerned

  v) The DSEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

Mini Project Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	15
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
2	Working Model	Problem Statement & Literature Survey (5M)	20
		Methodology& System Design (5M)	
		Implementation (5M)	

		Performance & Usability (5M)	
3	Mini Project Report	Structure, Format& Originality (5M)	15
		Technical Content (5M)	
		Clarity, Coherence & Writing (5M)	
4	Mini Project Paper	Structure, Organization & Academic Writing (5M)	10
		References, Citations & Originality (5M)	
5	Video Pitch	Content Clarity & Delivery (5M)	10
		Visual Quality & Presentation (5M)	
6	Oral Presentation / Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
7	Alignment with SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	

Course Articulation Matrix (CAM):		**U24AI612 MINI PROJECT**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI612.1**	3	3	2	3	3	2	1	2	1	2	2	2	1
CO2	**U24AI612.2**	2	2	2	3	2	1	1	1	2	1	3	1	1
CO3	**U24AI612.3**	1	1	1	1	2	2	1	2	3	1	2	1	1
CO4	**U24AI612.4**	1	2	1	2	2	1	2	1	3	1	2	1	1
U24AI612		1.75	**2**	**1.5**	**2.25**	**2.25**	**1.5**	**1.25**	**1.52**	**2.25**	**1.25**	**2.25**	**1.25**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation &	**SDG 9**	Industry, Innovation and Infrastructure	Mini projects involve the design and development of innovative ECE solutions such as IoT systems, embedded systems, communication networks, VLSI applications, and intelligent electronic devices. These activities promote technological innovation, entrepreneurship, and sustainable

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	entrepreneurship			industrial infrastructure.
CO2	demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report	**SDG 4**	Quality Education	Literature review, problem analysis, technical documentation, and independent learning enhance research skills, critical thinking, and lifelong learning capabilities, thereby supporting quality technical education and knowledge creation.
CO3	make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project	**SDG 11**	Sustainable Cities and Communities	Presentation and discussion of ECE-based solutions for smart cities, intelligent transportation systems, environmental monitoring, public safety, healthcare technologies, and digital connectivity contribute to sustainable and inclusive community development.
CO4	write a "Mini project paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project	**SDG 12**	Responsible Consumption and Production	Scientific reporting and dissemination of project outcomes promote responsible innovation, ethical publication practices, efficient utilization of resources, and sustainable technology development.

Semester -VI
Exit Option
Syllabi

Bridge Courses for exit:

Successful completion of two subjects (6-Credits) during 2-months internship at the institute

OR

Successful completion of two suitable skill based courses (external) to qualify for Certification

C. After Third Year: (B. Voc. in CSE (AI & ML))

(i) The candidate should pass any two of the following additional courses (Degree Level) during the 2-Months internship at institute

Exit Option to Qualify B. Voc in CSE (AI & ML):Any Two (02) Courses during the 2 - Months internship								
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**E**	**C**
1	PCC	U24AI613X	Robotic Process Automation	2	-	2	4	3
2	PCC	U24AI614X	Generative AI :Concepts and Applications	2	-	2	4	3
3	PCC	U24AI615X	Cloud Computing	2	-	2	4	3
4	PCC	U24AI616X	Ethical Hacking	2	-	2	4	3
5	PCC	U24AI617X	Any other course approved by BoS Chair and Dean AA	2	-	2	4	3

(OR)

(ii) Any two suitable skill based courses to qualify for B. Voc in CSE (AI & ML) Degree.

Exit Option to Qualify B. Voc in CSE (AI & ML): Any Two (02) Skill based Courses -:								
S. No.	**Category**	**Course Code**	**Course Title**	**L**	**T**	**P**	**E**	**C**
1	SEC	U24SE618X	Android Application Development Reference: https://nsdcindia.org/telecom-terminal-equipment-application-developer-android-application	-	-	6	6	3
2	SEC	U24SE619X	Big Data &Hadoop Reference: https://onlinecourses.nptel.ac.in/noc20_cs92/preview	-	-	6	6	3
3	SEC	U24SE620X	Introduction to Robotic Process Automation Reference: https://onlinecourses.nptel.ac.in/noc20_de11/preview	-	-	6	6	3
4	SEC	U24SE621X	Amazon Web Services Reference: https://www.coursera.org/specializations/aws-fundamentals	-	-	6	6	3
5	SEC	U24SE622X	Cyber Security Reference: https://onlinecourses.swayam2.ac.in/nou19_cs08/preview	-	-	6	6	3
6	SEC	U24SE623X	Augmented Reality & Virtual Reality Reference: https://www.coursera.org/learn/ar	-	-	6	6	3
7	SEC	U24SE624X	Any other skill based course approved by BoS Chair and Dean AA	-	-	6	6	3

ROBOTIC PROCESS AUTOMATION

Class: B. Tech. VI – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI613X**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**16 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

(based on cognitive skills acquired from theory component)

CO1 : understand fundamentals and business value of RPA, Tools, Lifecycle and Automation Anywhere

CO2 : design and develop automation solutions using Automation Anywhere control room basics, bot development, recorders and control commands with actions

CO3 : apply automation to Excel, Emails, Databases and Web access with error handling

CO4 : design and develop cognitive automation and intelligent automation IQ Bots, with security, governance, and best practices to Automate real-world business processes

UNIT-I	4 Hrs

Introduction & RPA Fundamentals: What is RPA and why it matters in business?, RPA benefits and limitations

RPA Lifecycle: Process identification & feasibility, ROI (Return on Investment) in automation

Task Bot Development: Creating Task Bots, Bot management, Variables and loops, Basic automation workflow

Variables & Controls and Commands and Actions: Variables and data types, Conditional logic, loops, Keystrokes, mouse operations, , Object cloning

UNIT-II	4 Hrs

Working with Files and Folders: File, Folder operations, CSV file, Data handling

Email Automation: Sending emails, Processing mailboxes

Automating Word: Document creation, Text manipulation, Word automation

UNIT-III	4 Hrs

Excel & Database Automation: Reading/writing Excel, Simple SQL data retrieval, Reading and writing Excel data, Spreadsheet automation, Data processing

Web Automation: Extracting web data, Interacting with browser elements

Working with XML Files: XML parsing, Data extraction, XML manipulation

UNIT-IV	4 Hrs

PDF Automation: Reading and Extracting information and images, Splitting and merging documents,

Managing Errors: Try-Catch-Finally, Exception handling, Logging and troubleshooting,

Error recovery mechanisms **Cognitive Automation (IQ Bots):** Introduction to cognitive automation, Document processing and validations.
Textbook(s): 1. HusanMahey, *Robotic Process Automation with Automation Anywhere*, Packt Publishing, 2020 *(Chapters 1 to 18)* 2. Alok Mani Tripathi, *Learning Robotic Process Automation*, Packt Publishing, 2018 *(Chapters 1 to 12)*
Reference Book(s): 1. Automation Anywhere University Documentation – Upskill Learning Paths 2. UiPath Academy documentation – RPA Developer Foundation
Web and Video link(s): https://www.shiksha.com/college/iit-kanpur-indian-institute-of-technology-25116/course-online-introduction-to-robotic-process-automation-using-uipath-1196003

Course Articulation Matrix (CAM):				U24AI613X: ROBOTIC PROCESS AUTOMATION										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI613X.1	1	2	1	1	-	1	1	1	1	1	1	1	1
CO2	U24AI613X.2	1	2	2	2	1	-	1	1	1	1	1	1	1
CO3	U24AI613X.3	1	2	2	2	1	-	1	1	2	1	1	1	1
CO4	U24AI613X.4	1	2	1	1	1	-	1	1	2	1	1	1	1
U24AI613X		1	2	1.5	1.5	1	1	1	1	1.5	1	1	1	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** The student should be able to…	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand fundamentals and business value of RPA, Tools, Lifecycle and Automation Anywhere	SDG3	Good Health and Well-being	Image pre-processing enhances medical images (MRI, CT, X-ray) by reducing noise and improving contrast, enabling accurate diagnosis and early disease detection.
CO2	Design and develop automation solutions using Automation Anywhere control room basics, bot development, recorders and control commands with actions	SDG9	Industry, Innovation and Infrastructure	Frequency domain filtering and restoration techniques improve image quality in industrial and satellite imaging systems, supporting reliable infrastructure monitoring and innovation.
CO3	Apply automation to Excel, Emails, Databases and Web access with error handling.	SDG11	Sustainable Cities and Communities	Image segmentation and morphological analysis enable applications like traffic analysis, surveillance, and urban monitoring, contributing to safer and smarter cities.
CO4	Design and Develop cognitive automation and intelligent automation IQ Bots, with security, governance, and best practices to Automate real-world business processes.	SDG9	Industry, Innovation and Infrastructure	Feature extraction and classification form the backbone of AI-driven systems such as autonomous vehicles, industrial automation, and smart analytics, fostering technological innovation.

GENERATIVE AI AND LARGE LANGUAGE MODELS

Class: B. Tech. VI – Semester (Exit Course)		**Branch:** CSE (AI&ML)	
Course Code	**U24AI614X**	**Credits**	**3**
Hours/Week (L-T-P- E)	**2-0-2-0-4**	**CIE**	**60%**
Total Number of Teaching Hours	**16 Hrs**	**ESE**	**40%**

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on…

LO1: Explain and analyze the foundational concepts of generative AI, latent representations, and probabilistic generative modeling.
LO2: implement and evaluate VAE and GAN-based models for generating and reconstructing synthetic data.
LO3: apply transformer architectures, LLM workflows, and prompt engineering strategies to solve text generation tasks.
LO4: develop and deploy scalable LLM-powered applications using fine-tuning, adaptation, and optimization techniques.

THEORY COMPONENT

UNIT-I	4 Hrs

Generative AI Overview: Data distributions and density estimation, Explicit vs Implicit generative models, Sampling vs inference, Applications: image synthesis, text generation, augmentation, Limitations and challenges

Latent Space & Representation Learning: Generative vs Discriminative modeling paradigms, Latent variables and embeddings, Continuous vs discrete latent spaces, Manifold hypothesis, Interpolation and latent arithmetic

Probabilistic Generative Modeling: Likelihood and maximum likelihood estimation (MLE), Approximate inference and variational inference, KL divergence and its interpretation, Evidence Lower Bound (ELBO) derivation (conceptual)

UNIT-II	4 Hrs

Variational Autoencoders (VAEs): Architecture and intuition, Reparameterization trick, KL regularization, Loss function, Applications

Generative Adversarial Networks (GANs): GAN framework, Generator-Discriminator training, Minimax objective, GAN training challenges, DCGAN, Conditional GANs, GAN Applications

UNIT-III	4 Hrs

Transformer Architecture: Self-attention, multi-head attention, Positional encoding, Encoder–decoder architecture, Decoder-only transformers, Causal language modeling, Masked language modeling, Scaling laws

LLMs: GPT-style models, Pretraining pieline, Fine-tuning pipeline, Tokenization, Embeddings, Emergent capabilities

Prompt Engineering: Zero-shot learning, few-shot learning, Instruction prompting, Chain-of-thought prompting, Prompt design strategies

UNIT-IV	4 Hrs
LLM-based Applications: Conversational AI, Dialogue systems (chatbots), Text summarization (extractive vs abstractive), Machine translation, Code generation, Program synthesis, Question answering systems, Content generation (reports, blogs, documentation) **LLM Adaptation and Deployment:** Fine-tuning vs prompt tuning, LoRA, Adapters, Parameter-efficient tuning, Instruction tuning, Alignment methods, Inference optimization, Model serving, API-based deployment, Latency considerations, scalability considerations	

LABORATORY COMPONENT

List of Experiments

1. Explore latent space representations and embedding visualization using dimensionality reduction techniques.
2. Implement probabilistic text generation and sampling techniques using temperature, top-k, and top-p sampling.
3. Build and train a Variational Autoencoder (VAE) for image generation or reconstruction.
4. Implement a Generative Adversarial Network (GAN/DCGAN) for synthetic image generation.
5. Study and implement text generation using pre-trained Generative AI/LLM APIs.
6. Implement prompt engineering techniques using zero-shot, one-shot, few-shot, and chain-of-thought prompting.
7. Build a Retrieval-Augmented Generation (RAG) system using embeddings and vector databases.
8. Develop a conversational AI chatbot with context-aware multi-turn interaction.
9. Implement text summarization and document question-answering using transformer-based LLMs.
10. Develop a multimodal Generative AI application integrating text and images (captioning or text-to-image generation).

Textbook(s):

1. David Foster, *Generative Deep Learning*, O'Reilly Media, 2nd edition, 2023, California. *(Chapters 1 to 6)*
2. Sebastian Raschka, *Build a Large Language Model (From Scratch)*, Manning Publications, 1st edition, 2024, New York. *(Chapters 2 to 9)*
3. Jay Alammar and Maarten Grootendorst, *Hands-On Large Language Models*, Shroff, 1st edition, 2024. *(Chapters 1 to 8)*

Reference Book(s):

1. Daniel Jurafsky, James H. Martin, *Speech and Language Processing*, Pearson, 3rd edition, 2023, New Jersey.
2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, *Natural Language Processing with Transformers*, O'Reilly Media, 1st edition, 2022, California.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 2nd edition, 2019, California.

Web and Video link(s):

https://onlinecourses.swayam2.ac.in/e-learning/preview/imb24_mg116; *NPTEL Video Lectures on Generative AI and Large Language Models by Prof. Naveen Kumar Bhansali, IIM Bangalore.*

<u>Laboratory Manual</u>:
Generative AI & LLM Laboratory Manual, Department of CSE (AI & ML), KITSW.

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1 : Analyze generative AI foundations, including latent space representations, probabilistic modeling, and density estimation techniques for data generation.

CO2 : Apply and analyze deep generative models such as VAEs, GANs, and diffusion models for designing and evaluating generative systems.

CO3 : Analyze and apply transformer-based large language models, prompt engineering, and retrieval-augmented techniques for advanced text generation tasks.

CO4 : Apply, evaluate, and deploy large language model–based systems, including prompting, retrieval-augmented generation, and multimodal extensions, for real-world applications.

CO5 : Analyze and implement foundational concepts of Generative AI including latent space representations, embeddings, probabilistic modeling, and sampling techniques for synthetic data generation.

CO6: Design and evaluate deep generative models such as Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), and diffusion models for image and data generation tasks.

CO7: Apply transformer-based large language models, prompt engineering strategies, embeddings, and retrieval-augmented generation techniques for advanced natural language processing applications.

CO8: Develop, fine-tune, and deploy LLM-based and multimodal AI applications including conversational systems, summarization, question answering, parameter-efficient tuning, and vision-language integrations.

Course Articulation Matrix (CAM):				**U24AI614X : GENERATIVE AI & LLMS**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI614X.1**	3	3	-	2	-	-	-	-	-	-	-	3	2
CO2	**U24AI614X.2**	3	3	2	2	2	-	-	-	-	-	-	3	3
CO3	**U24AI614X.3**	3	3	2	3	2	-	-	-	1	1	-	3	3
CO4	**U24AI614X.4**	2	3	3	3	3	-	-	-	2	2	1	3	3
CO5	**U24AI614X.5**	3	3	-	2	-	-	-	-	-	-	-	3	2
CO6	**U24AI614X.6**	3	3	2	2	2	-	-	-	-	-	-	3	3
CO7	**U24AI614X.7**	3	3	2	3	2	-	-	-	1	1	-	3	3
CO8	**U24AI614X.8**	2	3	3	3	2	-	-	-	2	2	1	3	3
U24AI614X		2.75	3	2.34	2.5	2.16	-	-	-	1.5	1.5	1	3	2.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CLOUD COMPUTING

Class: B. Tech. VI – Semester (Exit Course)		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI615X**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-0-2-0-4**	**CIE:**	**60%**
Total Number of Teaching Hours:	**16 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply cloud service models and deploy applications in public, private and hybrid cloud environments

CO2 : understand cloud architectures, virtualization concepts, containers and virtual machines

CO3 : implement cloud solutions using AWS, Azure, and GCP services such as compute, storage, networking and databases

CO4 : analyze cloud security, federated cloud models and advanced cloud technologies

UNIT-I	4 Hrs

Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environment, Computing platforms and technologies

Principles of Parallel and Distributive Computing: Eras of computing, Parallel vs. distributive computing, Elements of parallel computing, Elements of distributive computing, Technologies for distributive computing

UNIT-II	4Hrs

Virtualization: Introductions, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples

UNIT-III	4 Hrs

Data Intensive Computing: What is data intensive computing? Technologies for data intensive computing

Cloud Platform in Industry: Amazon web services, Google app engine, Microsoft Azure Cloud

UNIT-IV	4 Hrs

Advanced Topics in Cloud Computing: Federated clouds/Intercloud characterization and definition, Cloud federation stack, Aspects of interest, Technologies for cloud federation

Cloud Security: Security as a major concern for cloud users, Cloud security risks, Privacy and privacy impact assessment

Textbook(s):

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill, 2019, New Delhi. (Chapters 1, 2, 3, 4, 8, 10 and 11)
2. Dan C. Marinescu, *Cloud Computing Theory and Practice*, Elsevier, 2nd edition, 2018, Cambridge. (Chapter 9)

Reference Book(s):

1. Dr. Kumar Saurabh, Cloud Computing: Architecting Next-Gen Transformations Paradigms, Wiley India Private Limited, 4th edition, 2018, New Delhi.

2. Barrie Sosinsky, Cloud Computing Bible, Wiley Publications, 2011, Indiana. 3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw Hill, 2010, New York. 4. Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann, 3rd edition, 2013, USA.
Web and Video link(s):
https://onlinecourses.nptel.ac.in/noc21_cs14/preview; *NPTEL Video Lecture on Cloud Computing by Prof. Soumya Kanti Ghosh, Professor of Computer Science and Engineering, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI615X : CLOUD COMPUTING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI615X.1**	2	2	2	1	2	1	1	1	1	-	1	2	2
CO2	**U24AI615X.2**	2	2	2	1	2	1	1	1	1	-	1	2	2
CO3	**U24AI615X.3**	2	2	2	2	2	1	1	1	1	-	1	2	2
CO4	**U24AI615X.4**	2	2	2	2	2	1	1	1	1	-	1	2	2
U24AI615X		2	2	2	1.5	2	1	1	1	1	-	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply cloud service models and deploy applications in public, private and hybrid cloud environments	SDG9	Industry, Innovation and Infrastructure	Cloud computing environments (public, private, hybrid) enable scalable IT infrastructure, supporting digital transformation, industrial growth, and innovation
CO2	understand cloud architectures, virtualization concepts, containers and virtual machines	SDG9	Industry, Innovation and Infrastructure	Cloud architectures and virtualization technologies improve resource utilization, system efficiency, and infrastructure development, forming the backbone of modern IT systems
CO3	implement cloud solutions using AWS, Azure, and GCP services such as compute, storage, networking and databases	SDG8	Decent Work and Economic Growth	Cloud platforms like AWS, Azure, and GCP create employment opportunities, support startups, and drive economic growth through digital services and automation
CO4	analyze cloud security, federated cloud models and advanced cloud technologies	SDG13	Climate Action	Efficient cloud resource management, federated systems, and secure data handling reduce energy consumption and carbon footprint, contributing to sustainable and eco-friendly computing

ETHICAL HACKING

Class: B. Tech. VI – Semester (Exit Course)		**Branch:** CSE (AI&ML)	
Course Code:	U24AI616X	**Credits:**	**3**
Hours/Week (L-T-P- E):	**3-0-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**16 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand ethical hacking fundamentals, penetration testing, and information security concepts

CO2 : analyse business requirements, security policies, attack planning, and legal considerations

CO3 : apply reconnaissance, enumeration, and exploitation techniques to identify vulnerabilities

CO4 : evaluate security findings and recommend mitigation, defence planning, and incident management strategies

UNIT-I	4 Hrs

Introduction: Hacking Impacts, Types of hackers, Penetration testing framework, Information security models, Information security program

UNIT-II	4 Hrs

Business Perspective and Attack Planning: Business objectives and Security policy, Planning for a Controlled attack, Inherent and Imposed limitations, Attack types, Multi-Phased attacks, Teaming and Attack structure, Security consultant and Tester , Law enforcement

UNIT-III	4 Hrs

Reconnaissance, Enumeration, Exploitation: Reconnaissance techniques, Social engineering, Physical security, Technical preparation, Enumeration techniques, Elements of enumeration, Exploitation techniques, Evasion methods

UNIT-IV	4 Hrs

Deliverable and Integration: Deliverables in Ethical hacking, Overall structure, Integration of results, Integration summary, Mitigation, Defence planning, Incident management, Security policy

Textbook(s):

1. James S. Tiller, *The Ethical Hack: A Framework for Business Value Penetration Testing*, New York Auerbach Publications, 2019, CRC Press.

Reference Book(s):

1. Michael Simpson, Kent Backman, James Corley, *Hands-On Ethical Hacking and Network Defense*, 2nd edition, 2005, New York: Cengage Learning.
2. Patrick Engebreston, *The Basics of Hacking and Penetration testing*, 2011, New York: Syngress Publishers.
3. EC-Council, *Ethical Hacking and Countermeasures: Attack Phases*, 2016 New York: Course Technology Press.
4. Hein Smith, Hilary Morrison, *Ethical Hacking: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking,* Kindle Edition, 2018, New York.

Web and Video link(s):
https://onlinecourses.nptel.ac.in/noc22_cs13/preview, *NPTEL Online Course on Ethical Hacking, by Prof. Indranil Sen Gupta, Indian Institute of Technology Kharagpur.*

Course Articulation Matrix (CAM):		**U24AI616X: ETHICAL HACKING**											
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI616X.1**	2	2	2	1	-	1	-	1	-	1	-	1	1
CO2	**U24AI616X.2**	2	2	2	2	-	1	-	1	-	1	-	1	1
CO3	**U24AI616X.3**	2	2	2	2	-	1	-	1	-	1	-	2	1
CO4	**U24AI616X.4**	2	2	2	3	-	1	-	1	-	1	-	2	1
U24AI616X		2	2	2	2	-	1	-	1	-	1	-	1.5	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	understand ethical hacking fundamentals, penetration testing, and information security concepts.	SDG4	Quality Education	Develops cybersecurity knowledge, technical competencies, and industry-relevant skills through ethical hacking and information security education.
CO2	analyse business requirements, security policies, attack planning, and legal considerations.	SDG8	Decent Work & Economic Growth	Equips students with professional skills needed to secure business environments, support organizational growth, and meet industry cybersecurity requirements.
CO3	apply reconnaissance, enumeration, and exploitation techniques to identify vulnerabilities.	SDG9	Industry, Innovation and Infrastructure	Enhances the security and resilience of digital infrastructure by identifying vulnerabilities and supporting innovative cybersecurity solutions.
CO4	evaluate security findings and recommend mitigation, defence planning, and incident management strategies.	SDG16	Peace, Justice and Strong Institutions	Promotes secure information systems, effective cyber governance, risk management, and protection of organizational and public digital assets.

Semester -VII Syllabi

VII SEMESTER

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	OE	U24OE701X -MB	Open Elective –MB	2	1	-	3	3
2	PEC	U24AI702	Program Elective - II/ MOOCs-II	2	1	-	3	3
3	PCC	U24AI703	Quantum Computing Essentials	2	1		3	3
4	PCC	U24AI704	Cloud Computing	2	1	-	3	3
5	PCC	U24AI705	Generative AI : Concepts and Applications	2	1	-	3	3
6	PCC	U24AI706	Cloud Computing Laboratory	-	-	2	2	1
7	PCC	U24AI707	Generative AI : Concepts and Applications Laboratory	-	-	2	2	1
8	ELC	U24AI708	Internship Evaluation	-	-	2	2	1
9	ELC	U24AI709	Major Project Phase-1 / Industrial Internship -1	-	-	8	8	4
Total:				10	5	14	29	22
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	26

Pool -XX Management Courses Basket (OE-MB)		
S. No.	Course Code	Course Title
1.	U24OE701A-MB	Management Economics and Accountancy
2.	U24OE701B-MB	Engineering Finance
3.	U24OE701C-MB	OrganisationalBehaviour
4.	U24OE701D-MB	E-Commerce and Digital Marketing
5.	U24OE701Z-MB	Any other course approved by BoS Chair and Dean AA

Program Elective - II		
S. No.	Course Code	Course Title
1.	U24AI702A	Robotic Process Automation
2.	U24AI702B	Ethical Hacking
3.	U24AI702C	Privacy and Security in IoT
4.	U24AI702D	Web and Social Media Analytics
5.	U24AI702E	Cognitive Computing

MANAGEMENT ECONOMICS AND ACCOUNTANCY

Class: B. Tech. VII Semester	**Branch:** CSE, ECE, ECI, EEE/CSN, CSO, CSM, CSD, IT, CE, ME		
Course Code:	**U24OE701A-MB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: comprehend the basic concepts of management, functions of management

CO2 : distinguish between micro & macroeconomics & forms of business organizations

CO3: pass journal entries & post them into ledgers, prepare profit & loss accounts and assesses the financial position through the balance sheet

CO4: evaluate financial statements with the help of various ratios and reveal the financial health of the organization

UNIT-I	9 Hrs

Introduction to Management: Concept of Management, Features of Management, Importance of Management, Nature and Scope of Management, Fayol's Administrative Management, Taylor's Scientific Management

Functions of Management: Planning- Concept of Planning, Nature of Planning, Importance of Planning, Planning Process, Types of Planning, Organizing-Concept of Organizing, Organization Structure- line and staff, Advantages of Organizing, Staffing - Meaning, Functions of Human Resources Management, Directing- Elements of Directing- Supervision, Leadership- Nature, Motivation - Nature, Types, Communication- Process, Types, Barriers to effective communication, Co-ordination- Definition, Steps to achieve effective coordination, Controlling- Definition, Process

UNIT-II	9 Hrs

Economics: Meaning and definition, Scope, Micro and Macro Economics, Methods of Economics

Forms of Business Organization: Sole Proprietor ship, Partnership firm - Types of Partners, Limited Liability Partnership (LLP), Joint Stock Company - Features, Types, Merits and demerits, Cooperative society

UNIT-III	9 Hrs

Introduction to Financial Accounting: Accounting concepts and conventions, Double Entry System and Book Keeping, Overview of accounting cycle, Journal-meaning, Journalizing, Ledger - Meaning, Ledger posting, Balancing; Cash book (Single column), Preparation of Trial balance

Final Accounts: Trading Account, profit and loss account and Balance Sheet with simple adjustments

UNIT-IV	9 Hrs

Financial Statement Analysis: Introduction to Financial Statement Analysis, Ratio Analysis, Introduction, Types of Ratios, Analysis and Interpretation of Liquidity Ratios, Profitability ratios, Activity Ratios, and Capital structure Ratios (simple problems)

Textbook(s):

1. L.M.Prasad, *Principles and Practices of Management,* Sultan Chand & Sons Educational

Publishers, 11th edition.2025, New Delhi. (Part –1 to Part-6)

2. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, 2014. (Chapter-3)
3. R. Narayana Swamy, *Financial Accounting – A Managerial Perspective*, Prentice Hall of India, 7th edition, 2023, New Delhi.(Chapter-6)

Reference Book(s):

1. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 6th edition New Delhi: Tata Mc Graw Hill Publications, 2015.

2. Maheshwari, S. N., & Maheshwari, S. K. (2024). *Financial Accounting* 7th edition Vikas Publishing House Pvt. Ltd, 2024.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg52

https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10

Course Articulation Matrix (CAM):		**U24OE701A-MB : MANAGEMENT ECONOMICS AND ACCOUNTANCY**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE701A-MB.1**	-	3	3	2	-	2	2	3	3	3	3	1	1
CO2	**U24OE701A-MB.2**	-	2	2	-	-	2	3	3	3	3	3	1	1
CO3	**U24OE701A-MB.3**	-	1	2	1	-	2	3	2	3	3	3	1	1
CO4	**U24OE701A-MB.4**	-	2	2	2	-	1	2	-	3	2	3	1	1
		-	**2**	**2.25**	**1.67**	**-**	**1.75**	**2.5**	**2.67**	**3**	**2.75**	**3**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	comprehend the basic concepts of management	SDG 4	Quality Education	Understanding the management concepts and managerial function will help the students to take effective and efficient decisions and able to solve work place problems.
CO2	distinguish between micro & macro-economics & forms of business organizations	SDG 8	Decent Work and Economic Growth	Economics concepts will help to promote sustained, inclusive and sustainable economic growth, and different forms of organizations will provide knowledge about creating full and productive employment and decent work for all
CO3	pass journal entries & post them into ledgers, prepare profit & loss accounts and	SDG 17	Partnerships for the goals	accounting concepts and conventions will promote a universal, rules-based, open, non-

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	assesses the financial position through the balance sheet			discriminatory and equitable application of
CO4	evaluate financial statements with the help of various ratios and reveal the financial health of the organization	SDG 8	Decent Work and Economic Growth.	Evaluating financial statements through ratio analysis reveals the financial health of an organization, enabling better decision-making, efficient resource utilization, and sustainable growth.

ENGINEERING FINANCE

Class: B.Tech. VII -Semester	**Branch:** CSE, ECE, ECI, EEE/CSN, CSO, CSM, CSD, IT, CE, ME		
Course Code:	**U24OE701B-MB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept

CO2 : apply capital budgeting techniques including inflation adjusted Net Present Value/Internal Rate Return for project evaluation and selection

CO3: analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects

CO4: evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets

UNIT-I	**9 Hrs**

Fundamentals of Engineering Finance: Engineering Finance – Meaning, Definition, and Scope, Role of Finance in Engineering – Importance for engineers in decision making and cost control, Ethics in Engineering Finance – Transparency, Cost estimation honesty, Avoidance of financial conflicts of interest, Financial Management – Meaning, Functions, Objectives (profit maximization v/s. wealth maximization), Sources of Finance, Time value of Money

UNIT-II	**9 Hrs**

Investment Decisions: Investment Decisions- Types of Investment projects, Investment evaluation criteria, Methods of capital budgeting – Discounted cash flow techniques v/s. non discounted cash flow techniques, Inflation adjusted NPV and IRR, Comparison and selection of mutually exclusive engineering projects

UNIT-III	**9 Hrs**

Cost-Volume-Profit Analysis: Cost concepts- Fixed, Variable, Marginal, Sunk, Opportunity costs, Direct and Indirect costs, Breakeven analysis – Meaning, Assumptions, Graphical and Mathematical determination of breakeven point, Make or buy decisions using breakeven analysis, Application of breakeven analysis in engineering projects

UNIT-IV	**9 Hrs**

Replacement Decisions and Valuation of engineering assets: Replacement analysis – Meaning, Need, Defender v/s. Challenger concept, Economic service life, Valuation of equipment's and physical assets - Depreciation definition, Depreciation fund, Methods of depreciation - straight line, Declining balance, Sum of the years-digits, Sinking fund and Service output method, Application of depreciation methods on equipment's and physical asset with the passage of time

Textbook(s):

1. M Y Khan and P K Jain, *Financial Management,* Tata McGraw Hill 5th edition, ISBN:978-0-07-065614-7 *(Unit-I in part 1 of section 1,2&3 and Unit-II in part 3 of 9&10)*
2. R. Panneerselvam, *Engineering Economics,* PHI Learning 2nd edition, ISBN:978-81-203-4837-0 *(Unit-III in Chapter 1&16 and Unit-IV in Chapter 8& 9)*

Reference Book(s):

1. F.K. Crundwell, *Finance for Engineers: Evaluation and Funding of Capital Projects*, Springer London Ltd, Atlantic Publishers and Distributors (P) Ltd., ISBN: 978-1849967082, 2010.
2. Robert L. Kosowski, Salih N. Neftci, *Principles of financial engineering*, Academic press, Atlantic Publishers and Distributors (P) Ltd. 3rd edition, ISBN: 978-0123869685, 2014.
3. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th edition, ISBN: 9788126510887, 2014.
4. Prasanna Chandhra, *Financial Management: Theory and Practice,* Tata Mc Graw Hill Education (India) private limited, ISBN-10: 93-392-1225-8, 2015.
5. Chan S. Park, *Fundamentals of Engineering Economics,* Pearson Education. 3rd edition, ISBN: 978-9352864379, 2017.
6. Chatterjee Partha Sheikh Salim, *Engineering Economy & Financial Management*, Himalaya Publishing House, ISBN:978-9350247389, 2011.

Course Articulation Matrix (CAM):					**U24OE701B-MB: ENGINEERING FINANCE**								
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO 2**
CO1	**U24OE701B-MB.1**	2	-	-	-	-	-	2	-	-	2	2	1	1
CO2	**U24OE701B-MB.2**	-	3	-	-	2	-	-	-	-	-	3	1	1
CO3	**U24OE701B-MB.3**	-	-	2	-	-	-	-	2	-	2	-	1	1
CO4	**U24OE701B-MB.4**	-	-	2	2	-	2	-	-	-	2	2	1	1
		2	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**-**	**2**	**2.3**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept	SDG 4 and SDG 16	Quality Education and Peace, Justice and Strong Institutions	Promotes financial literacy, ethical decision-making, and professional responsibility essential for quality education and transparent institutional practices

CO2	Apply capital budgeting techniques including inflation adjusted NPV/IRR for project evaluation and selection	SDG 8 and SDG 9	Decent Work and Economic Growth And Industry, Innovation and Infrastructure	Supports economically viable investment decisions, efficient resource allocation, industrial growth, and sustainable infrastructure development
CO3	Analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects	SDG 9 and SDG 12	Industry, Innovation and Infrastructure and Responsible Consumption and Production	Encourages cost efficiency, optimized production planning, and responsible utilization of resources in engineering and industrial projects
CO4	Evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets	SDG 8 and SDG 12	Decent Work and Economic Growth and Responsible Consumption and Production	Promotes sustainable asset management, economic efficiency, lifecycle optimization, and responsible use of engineering resources

ORGANIZATIONAL BEHAVIOUR

Class: B.Tech.VII – Semester	Branch: CSE, ECE, ECI, EEE/CSN, CSO, CSM, CSD, IT, CE, ME		
Course Code:	U24OE701C-MB	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**40%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**60%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: evaluate the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour

CO2 : analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation

CO3: examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings

CO4: evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour

UNIT-I	9 Hrs

Introduction: Foundations of organizational behavior, Concept, Importance, Factors influencing organizational behavior, Challenges and opportunities for organization behavior, Managerial perspective of OB, Communication-Process-channels-communication barriers, Measures to overcome barriers

UNIT-II	9 Hrs

Individual Behavior: Individual in the organization, Nature of man, Models of man, Personality-Stages of development of personality, Perception-Factors influencing perception, Learning-Theories of Learning-Cognitive Learning Theory, Behaviourist Learning Theory, Attitudes-Formation of attitudes, Personality and emotions, Managing emotions and stress in organizations, Motivation- Motivation theories-Maslow's Needs Hierarchy Theory and Herzberg's Two-Factor Theory

UNIT-III	9 Hrs

Group decision making: Groups in organization, Basic group concepts, Groups vs. Teams, understanding work teams-Types of teams, Creating effective teams, Conflicts-Types of conflicts, Strategies for resolution of conflicts in groups

Group dynamics: Group dynamics, Leadership-Leadership types and managerial effectiveness, Trust and leadership, Power and politics, Basis of power, Organizational politics

UNIT-IV	9 Hrs

Organization structure: Organization structure, Size and design, Organizational culture, Organizational change -Resistance to change, Organizational stress- Factors contribute to stress, Coping strategies, Stress and performance, Organizational effectiveness-concepts, Quality of work life-concepts, International organizational

behavior-concepts
Textbook(s): 1. Stephen P. Robbins, Timothy A. Judge & Neharika Vohra, *Organizational Behavior, Pearson India, 18th edition*, 2022, New Delhi. (Chapter 1 to 4) 2. K. Aswathappa, *Organizational Behaviour, Himalaya Publishing House, 14th edition*, 2021, Mumbai. (Chapter 1 to 4)
Reference Book(s): 1. Fred Luthans, *Organizational Behavior, McGraw Hill Education, 13th edition*, 2020, New York. 2. Uma Sekaran, *Organizational Behavior: Text and Cases, McGraw Hill Education, 2nd edition*, 2019, New Delhi. 3. S. S. Khanka, *Organizational Behavior, S. Chand Publishing, 11th edition*, 2021, New Delhi.
Web and Video link(s): 1. Harvard Business Review – Organizational Behavior Articles and Videos; Web resources and expert videos on leadership, teamwork, communication, conflict management, and organizational effectiveness.

Course Articulation Matrix (CAM)					U24OE701C-MB: ORGANIZATIONAL BEHAVIOUR									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24OE701C-MB.1	2	-	-	-	-	-	-	2	2	-	-	1	1
CO2	U24OE701C-MB.2	-	3	-	-	-	-	2	--	-	-	3	1	1
CO3	U24OE701C-MB.3	-	2	-	-	-	-	-	2	2	2	-	1	1
CO4	U24OE701C-MB.4	-	-	2	-	-	2	-	-	-	2	2	1	1
		2	2.5	2	-	-	2	2	2	2	2	2.5	1	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Explain the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour	SDG 4	Quality Education	Understanding organizational behaviour and communication processes helps students develop professional knowledge, communication, and workplace learning skills
CO2	Analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation	SDG 3	Good Health and Well-being	Analysing emotions, stress, motivation, and attitudes promotes mental well-being, self-management, and healthy work practices
CO3	Examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings	SDG 16	Peace, Justice and Strong Institutions	Studying leadership, conflict management, teamwork, and group dynamics supports inclusive, cooperative, and effective organizational practices
CO4	Evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour	SDG 8	Decent Work and Economic Growth	Evaluating organizational culture, innovation, quality of work life, and change management supports productive employment and sustainable organizational growth

E-COMMERCE & DIGITAL MARKETING

Class: B. Tech. VII – Semester	**Branch:** CSE, ECE, ECI, EEE/CSN, CSO, CSM, CSD, IT, CE,ME		
Course Code:	**U24OE701D-MB**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: interpret the concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions

CO2 : analyze e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions

CO3: evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment

CO4: determine digital marketing channels and design effective online marketing plans

UNIT-I	9 Hrs

Introduction to E-Commerce: E-Commerce – Introduction, Definition, Scope, Evolution, Internet Commerce vs E-Commerce, Electronic Commerce Market, E-Commerce Industry Framework, Trade Cycle in E-Commerce, Electronic Data Interchange (EDI), E-Commerce Functions, Types of E-Commerce – B2B, B2C, C2C, C2B, B2G, G2B, and G2C, Forces fuelling E-Commerce – Differences between Traditional Commerce and E-Commerce, Limitations of E-Commerce, Introduction to Artificial Intelligence (AI) in E-Commerce

UNIT-II	9 Hrs

E-payment Systems: Digital payment Requirements, Types of E-Payment Systems - Digital Token-based E-payment systems, Credit card as E-payment system, Mobile payments, smart card cash payment system, Micropayment system, E-Security, E- Cash, E-Finance: Areas of Financing; E-Banking - Traditional Banking Vs. E-Banking, Operations in E-Banking, E-Trading – Stock Market trading, Importance and advantages of E-Trading **Legal Framework for E-Commerce:** E-Commerce Legal Framework - The Information Technology Act 2000, Information Technology (Amendment) Act, 2008, Copyrights, Defamation, Privacy, Contracts, Taxation, Signing a contract Electronically, Domain name and Registration

UNIT-III	9 Hrs

Digital Marketing: Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends, Marketing in the Digital Era: Segmentation – Importance of Audience Segmentation, different segments used in Digital Media – Organizational characteristics, purchasing characteristics, using Digital Media to Reach, acquisition and retention of new customers, Digital Media for Customer Loyalty

UNIT-IV	9 Hrs

Channels of Digital Marketing: Digital Marketing, Website Marketing, Search Engine Marketing, Search Engine optimization, Online Advertising, Email Marketing-Campaign

Design, Automation, Personalization, Blog Marketing-Content Creation, Blogging Platforms, Social Media Marketing-Marketing through Facebook, Instagram, LinkedIn, X (Twitter), and YouTube, Audio, Video and Interactive Marketing, Mobile Marketing, Digital Marketing Plan: Need for Digital Marketing Plan, Elements of Digital Marketing Plan, Writing the Marketing Plan and Implementation
Textbook(s): 1. C. S. V. Murthy- *E-Commerce: Concepts, Models & Strategies*, Himalaya Publishing House 2nd - Edition (2025). 2. Seema Gupta – *Digital Marketing*, McGraw-Hill 3rd Edition, 2022/2023. 3. Tracy L. Tuten & Michael R. Solomon – *Social Media Marketing*, SAGE Publication, 5th Edition, 2023.
Reference Book(s): **1.** Matthew Reynolds – *Beginning E-Commerce with Visual Basic, ASP, SQL Server 7.0 & MTS*, published by Wrox Publisher. **2.** P. T. Joseph, S.J. *E-Commerce: An Indian Perspective, Latest Edition*: 7th Edition (2023) Publisher: PHI Learning Pvt. Ltd. **3.** Michael Miller – *B2B Digital Marketing: Using the Web to Market Directly to Businesses* 1st Edition (2012; Indian reprint 2014/2015) Pearson India / Que Publishing.
Web and Video link(s): 1. https://youtu.be/qnBhOVH1QQ8?si=6UtzpR5d6t8Rk5da Digital Marketing Full Course 2026 In 24 Hrs | Digital Marketing Tutorial for Beginners 2. https://youtu.be/qsO_YCjgBFI?si=zVdKwrU8l6eEr4wg

Course Articulation Matrix (CAM):		**U24OE701D-MB: E-COMMERCE & DIGITAL MARKETING**											
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24OE701D-MB.1**	2	2	1	-	2	1	-	-	1	-	2	1	1
CO2	**U24OE701D-MB.2**	2	2	1	1	2	2	1	-	1	1	1	1	1
CO3	**U24OE701D-MB.3**	2	2	2	1	2	1	1	1	2	1	2	1	1
CO4	**U24OE701D-MB.4**	2	2	2	2	2	1	1	2	2	2	2	1	1
		2	**2**	**1.5**	**1.3**	**2**	**1.25**	**1**	**1.5**	**1.5**	**1.3**	**1.75**	**1**	1
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand the concepts, scope, types, functions, framework, opportunities, and limitations of E-Commerce, and analyse its role in modern business and electronic transactions	SDG 8	Decent Work and Economic Growth	E-Commerce promotes entrepreneurship, digital business growth, employment opportunities, and innovation in the global economy
CO2	Analyse e-payment systems, e-finance operations, e-banking, e-trading, and the legal framework governing e-commerce transactions	SDG 9	Industry, Innovation and Infrastructure	Digital payment systems and e-banking strengthen technological infrastructure, financial inclusion, and innovation in digital industries
CO3	Evaluate digital marketing practices, emerging trends, and consumer behaviour in the online environment	SDG 12	Responsible Consumption and Production	Digital marketing helps organizations understand consumer behaviour and promote sustainable and responsible consumption patterns
CO4	Analyze digital marketing channels and design effective online marketing plans	SDG 17	Partnerships for the Goals	Digital marketing channels improve global communication, collaboration, networking, and partnerships among businesses and stakeholders

ROBOTIC PROCESS AUTOMATION

Class: B. Tech. VII – Semester		**Branch:** CSE (AIML)	
Course Code:	**U24AI702A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand fundamentals and business value of RPA, Tools, Lifecycle and Automation Anywhere

CO2 : design and develop automation solutions using Automation Anywhere control room basics, bot development, recorders and control commands with actions

CO3 : apply automation to Excel, Databases and Web access with error handling.

CO4 : design and Develop cognitive automation and intelligent automation IQ Bots, with security, governance, and best practices to Automate real-world business processes.

UNIT-I	9 Hrs

Introduction & RPA Fundamentals: What is RPA and why it matters in business?, RPA benefits and limitations

RPA Lifecycle: Process identification & feasibility, ROI (Return on Investment) in automation

Introduction to Automation Anywhere: Architecture & components, Bots: Task Bots, Meta Bots, IQ Bots

Control Room Basics: Logging in, user roles, dashboard navigation

Task Bot Development: Creating Task Bots, Bot management, Variables and loops, Basic automation workflow

Variables & Controls and Commands and Actions: Variables and data types, Conditional logic, loops, Keystrokes, mouse operations, Object cloning

UNIT-II	9 Hrs

Working with Files and Folders: File operations, Folder management, CSV file operations, Data handling

Email Automation: Sending emails, Processing mailboxes, Email-based workflows

Automating Word: Document creation, Text manipulation, Word automation,

PDF Automation: Reading and Extracting information and images, Splitting and merging documents, Encrypting and decrypting documents, Using the PDF dictionary

UNIT-III	9 Hrs

Excel & Database Automation: Reading/writing Excel, Simple SQL data retrieval, Reading and writing Excel data, Spreadsheet automation, Data processing

Web Automation: Extracting web data, Interacting with browser elements

Working with XML Files: XML parsing, Data extraction, XML manipulation

Managing Errors: Try-Catch-Finally, Exception handling, Logging and troubleshooting, Error recovery mechanisms

UNIT-IV	9 Hrs

Running External Scripts: VBScript integration, Python script execution, Parameter passing, Function return values

Control Room Advanced Features: Scheduling bots, Monitoring logs & audit trails.

Cognitive Automation (IQ Bots): Introduction to cognitive automation, Document processing and validations,

Intelligent Automation Concepts: Overview of integrating RPA with AI technologies, Basic OCR use cases, Best Practices & Real-World Use Cases, Enterprise automation workflows,

Capstone Project: End-to-end bot creation, Deployment and evaluation
Textbook(s): 1. Husan Mahey, "*Robotic Process Automation with Automation Anywhere*", Packt Publishing, November 2020. (Chapters 1 to 18) 2. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018. Chapters 1 to 12)
Reference Book(s): 1. Automation Anywhere University, "*Upskill Learning Paths*", Automation Anywhere learning Platform, 2026 2. UiPath Academy, "*RPA Developer Foundation*", UIPath, Online Learning Platform, 2026.
Web and Video link(s): https://www.shiksha.com/college/iit-kanpur-indian-institute-of-technology-25116/course-online-introduction-to-robotic-process-automation-using-uipath-1196003

Course Articulation Matrix (CAM): U24AI702A ROBOTIC PROCESS AUTOMATION														
Course Outcomes		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI702A.1**	1	2	1	1	-	1	1	1	1	1	1	1	1
CO2	**U24AI702A.2**	1	2	2	2	1	-	1	1	1	1	1	1	1
CO3	**U24AI702A.3**	1	2	2	2	1	-	1	1	2	1	1	1	1
CO4	**U24AI702A.4**	1	2	1	1	1	-	1	1	2	1	1	1	1
U24AI702A		1	2	1.5	1.5	1	1	1	1	1.5	1	1	1	1

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand fundamentals and business value of RPA, Tools, Lifecycle and Automation Anywhere	SDG 4, SDG 8	Quality Education, Decent Work and Economic Growth	Develops digital skills and automation literacy, preparing students for Industry 4.0 and enhancing workforce productivity.
CO2	Design and develop automation solutions using Automation Anywhere control room basics, bot development, recorders and control commands with actions	SDG 4, SDG 9	Decent Work and Economic Growth, Industry, Innovation and Infrastructure	Promotes process innovation, operational efficiency, and adoption of advanced digital technologies in organizations.
CO3	Apply automation to Excel, Emails, Databases and Web access with error handling.	SDG 9 SDG 12	Industry, Innovation and Infrastructure, Responsible Consumption and Production	Improves resource utilization, reduces manual errors, minimizes operational waste, and supports efficient business processes.
CO4	Design and Develop cognitive automation and intelligent automation IQ Bots, with security, governance, and best practices to Automate real-world business processes.	SDG 9 SDG 8 SDG 16	Industry, Innovation and Infrastructure, Decent Work and Economic Growth, Peace, Justice and Strong Institutions	Encourages intelligent automation, secure digital transformation, governance, compliance, transparency, and sustainable business operations.

ETHICAL HACKING

Class: B. Tech. VII– Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI702B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand the fundamentals of ethical hacking, including types of hackers, hacking impacts, and the structured penetration testing framework

CO2 : explain information security models, security architecture, and components of an information security program, including risk analysis and ethical considerations

CO3 : apply business and organizational perspectives to plan controlled security testing by considering policies, constraints, and attack strategies

CO4 : analyze and apply reconnaissance, enumeration, and exploitation techniques to identify and assess system vulnerabilities

UNIT-I	9 Hrs

Introduction: Hacking impacts, Introduction to AI-powered Cyber Attacks, AI in offensive and defensive security, The hacker -Type of hacker, Script kiddies

Framework: Planning the test, Sound operations, Reconnaissance, Enumeration, Vulnerability analysis, Exploitation, Final analysis, Deliverable, Integration, Penetration Testing Methodology and Types

Information Security Models: Computer security, Network security, Service security, Application security, Security architecture

Information Security Program: The process of information security, Component parts of information, security programs, Risk analysis and ethical hacking

UNIT-II	9 Hrs

The Business Perspective: Business objectives, Security policy, Previous test results, Business challenges

Planning for a Controlled Attack: Inherent limitations, Imposed Limitations, Timing is Everything, Attack type, Source point, Required knowledge, Multi-phased Attacks, Teaming and attack structure, Engagement planner, The right security consultant, The tester, logistics, Intermediates, Law enforcement

UNIT-III	9 Hrs

Reconnaissance: AI-assisted Reconnaissance, AI-generated phishing, AI-based Social Engineering, Physical security, Internet reconnaissance

Preparing for a Hack: Technical preparation, Managing the engagement

Enumeration: Enumeration techniques, Soft Objective, Looking around or attack, Elements of enumeration, Preparing for the next phase

Exploitation: AI-assisted Vulnerability Discovery and Exploitation, Intuitive testing, Evasion, Threads and groups, Operating systems, Password crackers, Rootkits, Applications, War Dialing, Network, Services and areas of concern

UNIT-IV	9 Hrs

Deliverable: The deliverable, the document, Vulnerability assessment report, Penetration test report, Overall structure, Aligning findings, Presentation

Integration: Integrating the results, Integration summary, Mitigation, Defense planning, Incident management, Security policy, Conclusion

Textbook(s):

1. James S. Tiller, *The Ethical Hack: A Framework for Business Value Penetration Testing*, Auerbach Publications, CRC Press, 2019, New York.

Reference Book(s):

1. Michael Simpson, Kent Backman, James Corley, *Hands-On Ethical Hacking and Network Defense*, 2nd edition, Cengage Learning, 2005, New York.
2. Patrick Engebreston, *The Basics of Hacking and Penetration testing*, Syngress Publishers, 2011, New York.
3. EC-Council, *Ethical Hacking and Countermeasures: Attack Phases*, Course Technology Press, 2016, New York.
4. Hein Smith, Hilary Morrison, *Ethical Hacking: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking,* Kindle Edition, 2018, New York.
5. Clarence Chio & David Freeman, *Machine Learning and Security*, O'Reilly Media.
6. Mark Stamp, *Introduction to Machine Learning with Applications in Information Security,* CRC Press.
7. Georgia Weidman, *Penetration Testing: A Hands-On Introduction to Hacking,* No Starch Press.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_cs13/preview, *NPTEL Online Course on Ethical Hacking, by Prof. Indranil Sen Gupta, Indian Institute of Technology Kharagpur.*

Course Articulation Matrix (CAM):				U24AI702B: ETHICAL HACKING										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI702B.1**	2	2	2	1	-	1	-	1	-	1	-	1	1
CO2	**U24AI702B.2**	2	2	2	2	-	1	-	1	-	1	-	1	1
CO3	**U24AI702B.3**	2	2	2	2	-	1	-	1	-	1	-	2	1
CO4	**U24AI702B.4**	2	2	2	3	-	1	-	1	-	1	-	2	1
U24AI702B		2	2	2	2	-	1	-	1	-	1	-	1.5	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	understand the fundamentals of ethical hacking, including types of hackers, hacking impacts, and the structured penetration testing framework.	SDG9	Industry, Innovation and Infrastructure	Ethical hacking strengthens digital infrastructure and cybersecurity, which are essential for resilient and secure technological systems.
CO2	explain information security models, security architecture, and components of an information security program, including risk analysis and ethical considerations.	SDG9	Industry, Innovation and Infrastructure	Information security frameworks support the development of secure, reliable, and sustainable digital infrastructure.
CO3	apply business and organizational perspectives to plan controlled security testing by considering policies, constraints, and attack strategies.	SDG8	Decent Work and Economic Growth	Security testing and risk management help organizations protect assets, ensure business continuity, and promote secure economic growth and innovation.
CO4	analyze and apply reconnaissance, enumeration, and exploitation techniques to identify and assess system vulnerabilities.	SDG9	Industry, Innovation and Infrastructure	Vulnerability assessment and penetration testing improve cybersecurity resilience and protect critical digital infrastructure.

PRIVACY AND SECURITY IN IOT

Class: B. Tech. VII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI702C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze IoT security requirements, architecture and security concerns

CO2 : apply security mechanisms and protection techniques in IoT systems

CO3 : identify IoT threats, vulnerabilities, attacks, and countermeasures

CO4 : evaluate network attacks, defense strategies, and robustness in IoT systems

UNIT-I	9 Hrs

Securing the Internet of Things: Introduction, Security requirements in IoT architecture, Security in enabling technologies, Security concerns in IoT applications

Security Architecture in the Internet of Things: Introduction, Security requirements in IoT, Insufficient authentication/authorization, Insecure access control, Threats to access control, Privacy and availability, Attacks specific to IoT

UNIT-II	9 Hrs

Security and Vulnerability in the Internet of Things: Secrecy and secret-key capacity, Authentication/authorization for smart devices, Transport encryption, Transport layer security, Secure sockets layer, HTTPS, Transport trust in IoT, Secure cloud/web interface, Secure software/firmware, Physical layer security

UNIT-III	9 Hrs

Internet of Things as Interconnections of Threats: Phase attacks, Data leakage or breach, Data sovereignty, Data loss, Data authentication, Attack on availability, Modification of sensitive data

Attacks as per architecture: External attack, Wormhole attack, Selective forwarding attack, Sinkhole attack, Sewage pool attack, Witch attack, HELLO flood attacks, Addressing all things in IoT, Confidentiality, Physical security, Software security, Network security, Data protection, Incomplete data deletion

UNIT-IV	9 Hrs

Attack, Defense and Network Robustness of Internet of Things: Introduction, Centrality attacks, Network resilience and topological defense scheme, Game-theoretic analysis of network robustness and fusion-based defense scheme, Sequential defense scheme

Textbook(s):

1. Shancang Li, Li Da Xu, *Securing the Internet of Things*, 1st edition, Syngress, Elsevier, 2017. *(Chapters 1 and 2)*
2. Fei Hu, *Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations*, 1st edition, CRC Press, 2016. *(Chapters 3 and 4)*

Reference Book(s):

1. Sudip Misra, Anandarup Mukherjee and Arijit Roy, *Introduction to IoT*, 1st edition, Cambridge University Press, 2022.
2. Colin Dow and Perry Lea, *Mastering IOT: Build modern IoT solutions that secure and monitor your IoT infrastructure*, 1st edition, Packt Publishings, 2019.
3. Brian Russell and Drew Van Duren, *Practical Internet of Things Security*, 1st edition, Packt Publishing, 2016.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs37/preview; *NPTEL Video Lecture on Introduction To Internet Of Things by Prof. Sudip Misra, Professor of CSE, IIT Kharagpur.*

Course Articulation Matrix (CAM):		U24AI702C: PRIVACY AND SECURITY IN IOT												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI702C.1	2	2	1	1	1	1	2	0	1	0	1	2	2
CO2	U24AI702C.2	2	2	2	1	2	1	2	1	1	0	1	2	2
CO3	U24AI702C.3	2	2	1	2	1	1	2	1	1	0	2	2	2
CO4	U24AI702C.4	2	2	2	2	2	2	2	1	1	1	2	2	2
U24AI702C		**2**	**1.75**	**1.5**	**1.5**	**1.5**	**1.25**	**2**	**1**	**1**	**1**	**1.5**	**2**	**2**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Analyze IoT security requirements, architecture, and security concerns	SDG9	Industry, Innovation and Infrastructure	Secure IoT architectures strengthen reliable, resilient, and innovative digital infrastructure, enabling safe deployment of IoT technologies across industries.
CO2	Apply security mechanisms and protection techniques in IoT systems	SDG9	Industry, Innovation and Infrastructure	Security technologies improve the reliability, resilience, and innovation of IoT-enabled infrastructure and industrial systems.
CO3	Identify IoT threats, vulnerabilities, attacks, and countermeasures	SDG9	Industry, Innovation and Infrastructure	Identifying and mitigating cyber threats enhances the resilience, reliability, and secure operation of IoT infrastructure and connected systems.
CO4	Evaluate network attacks, defense strategies, and robustness in IoT systems	SDG11	Sustainable Cities and Communities	Robust and secure IoT networks support smart city services, public safety, and sustainable urban infrastructure.

WEB AND SOCIAL MEDIA ANALYTICS

Class: B. Tech. VII – Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI702D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply the concepts of business intelligence, decision support systems, business analytics, and big data analytics

CO2 : analyze textual data using text mining, natural language processing, and sentiment analysis techniques

CO3 : apply web mining and web analytics techniques to analyze web data and evaluate website performance

CO4 : interpret social media data using social analytics and social network analysis techniques, and apply prescriptive analytics methods

UNIT-I	9 Hrs

An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to manage a vaccine supply chain effectively and safely, Changing business environments and computerized decision support, Information systems support for decision making, The concept of Decision Support Systems (DSS), Business analytics overview, Brief introduction to big data analytics, Introduction to predictive analytics using decision trees and linear regression

UNIT-II	9 Hrs

Text Analytics and Text Mining: Machine versus Men on jeopardy, The story of watson, Text analytics and text mining concepts and definitions, Natural Language Processing: TF-IDF, Naïve Bayes Algorithm, Text mining applications, Text mining process, Text mining tools

Sentiment Analysis: Sentiment analysis overview, Sentiment analysis applications, Sentiment analysis process, Sentiment analysis and speech analytics

UNIT-III	9 Hrs

Web Analytics, Web Mining: Security first insurance deepens connection with policyholders, Web mining overview, Web content and web structure mining, PageRank and HITS Algorithms, Search engines, Search engine optimization, Web usage mining, Web analytics maturity model and web analytics tools

UNIT-IV	9 Hrs

Social Analytics and Social Network Analysis: Social analytics and social network analysis, Social media definitions and concepts, Social media analytics, Degree Centrality and Community Detection (Girvan–Newman Algorithm)

Prescriptive Analytics - Optimization and Multi-Criteria Systems: Multiple goals, Sensitivity analysis, What-if analysis and goal seeking

<u>Textbook(s):</u>

1. Ramesh Sharda, Dursun Delen, Efraim Turban, *Business Intelligence and Analytics: Systems for Decision Support*, 10th edition, *Pearson Education*, 2015, New Jersey, USA.

Reference Book(s):

1. Foster Provost and Tom Fawcett, *Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking*, 1st edition, O'Reilly Media, 2013, Sebastopol, California, USA.
2. Jim Sterne, *Social Media Metrics: How to Measure and Optimize Your Marketing Investment*, 1st edition, Wiley Publishing, 2010, Hoboken, New Jersey, USA.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal, *Data Mining: Practical Machine Learning Tools and Techniques,* 4th edition, Morgan Kaufmann (Elsevier), 2017, Burlington, Massachusetts, USA.
4. Matthew A. Russell and Mikhail Klassen, *Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Instagram, GitHub, and More*, 3rd edition, O'Reilly Media, Inc., 2019, Sebastopol, California, USA.

Web and Video link(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs117/preview *NPTEL Video Lecture on Social Network Analysis by Prof. Balaraman Ravindran, Department of Computer Science and Engineering, IIT Madras*
2. https://onlinecourses.nptel.ac.in/noc26_cs82/preview *NPTEL Video Lecture on Social Networks by Prof. Sudarshan Iyengar, Department of Computer Science and Engineering, IIT Ropar*

Course Articulation Matrix (CAM):				U24AI702D: WEB AND SOCIAL MEDIA ANALYTICS									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI702D.1	2	2	2	1	1	1	1	-	1	-	1	2	2
CO2	U24AI702D.2	2	2	2	1	1	1	1	-	1	-	1	2	2
CO3	U24AI702D.3	2	2	2	1	1	1	1	-	1	-	1	2	2
CO4	U24AI702D.4	2	2	2	1	1	1	1	-	1	-	1	2	2
U24AI702D		2	2	2	1	1	1	1	-	1	-	1	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply the concepts of business intelligence, decision support systems, business analytics, and big data analytics	SDG9	Industry, Innovation and Infrastructure	Application of business intelligence, decision support systems, and analytics enables data-driven innovation, efficient infrastructure management, and improved organizational decision-making.
CO2	analyze textual data using text mining, natural language processing, and sentiment analysis techniques	SDG8	Decent Work and Economic Growth	Analysis of textual and sentiment data helps organizations understand customer needs, improve services, and support informed business decisions that contribute to economic growth and productivity.
CO3	apply web mining and web analytics techniques to analyze web data and evaluate website performance	SDG4	Quality Education	Application of web mining and web analytics techniques promotes data literacy, analytical skills, and effective utilization of digital information resources for continuous learning and knowledge enhancement.
CO4	interpret social media data using social analytics and social network analysis techniques, and apply prescriptive analytics methods	SDG9	Industry, Innovation and Infrastructure	Social media analytics and prescriptive analytics facilitate innovation, strategic planning, and evidence-based decision-making for sustainable business and industrial development

COGNITIVE COMPUTING

Class: B. Tech. VII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI702E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : design and develop cognitive computing applications using ai platforms and augmented intelligence tools.

CO2 : implement cognitive modeling techniques such as bayesian, connectionist, and logic-based models for intelligent problem-solving.

CO3 : develop memory and language-based computational models for healthcare, education, and human-centered ai applications.

CO4 : build intelligent reasoning and decision-support systems using cognitive architectures for real-world applications.

UNIT-I	9 Hrs

Introduction to computational cognitive modelling, Cognition Modeling Paradigms: Connectionist Models of Cognition, Bayesian Models of Cognition, Dynamical Systems Approaches to Cognition, Declarative/Logic-Based Cognitive Modeling, Constraints in Cognitive Architectures.

UNIT-II	9 Hrs

Computational modeling of various cognitive functionalities and domains: Computational Models of Episodic Memory, Computational Models of Semantic Memory, Models of Categorization, Micro-Process Models of Decision Making, Models of Inductive Reasoning, Mental Logic, Mental Models, and Simulations of Human Deductive Reasoning.

UNIT-III	9 Hrs

Computational Models of Skill Acquisition, Computational Models of Implicit Learning, Computational Models of Attention and Cognitive Control, Computational Models of Developmental Psychology, Computational Models of Psycholinguistics, Computational Models in Personality and Social Psychology.

UNIT-IV	9 Hrs

Cognitive Modeling for Cognitive Engineering: Introduction to Cognitive Engineering, Historical Foundations, Cognitive Models in Human-Computer Interaction (HCI), Cognitive Architectures for Engineering Applications, Computational Modeling of Visual Information Processing, An Evaluation of Computational Modeling in Cognitive Science.

Textbook(s):

1. Ron Sun, *The Cambridge Handbook of Computational Psychology*, 1st edition, New York: Cambridge University Press, 2008.

Reference Book(S):

1. Emmanuel M. Pothos, Andy J. Wills, *Formal Approaches in Categorization*, 1st edition, New York: Cambridge University Press, 2011.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, *Cognitive Computing and Big Data Analytics*, 1st edition, Wiley: Indianapolis 2015.
3. Vijay V. Raghavan, Venkat N. Gudivada, Venu Govindaraju, *Cognitive Computing: Theory and Applications, Volume 35 (Handbook of Statistics)*, 1st edition, North Holland: Amsterdam, 2016.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_ee122/preview; *NPTEL Video Lecture on congnition its computation by Prof. Sharba Bandyopadhyay, Prof. Rajlakshmi Guha, IIT Kharagpur.*

Course Articulation Matrix (CAM):				U24AI702E: COGNITIVE COMPUTING									
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**U24AI702E.1**	2	2	2	1	2	-	-	1	1	1	-	2	2
CO2	**U24AI702E.2**	2	3	2	2	2	-	-	1	1	1	-	2	2
CO3	**U24AI702E.3**	2	2	2	3	2	-	-	1	1	1	-	2	3
CO4	**U24AI702E.4**	1	2	2	3	2	-	-	1	1	1	-	2	3
U24AI702E		1.75	2.25	2	2.25	2	-	-	1	1	1	-	2	2.50
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Design and develop cognitive computing applications using ai platforms and augmented intelligence tools.	SDG 9	Industry, Innovation and Infrastructure	Cognitive computing promotes intelligent automation, AI-driven innovation, and advanced computational infrastructure for modern industries.
CO2	Implement cognitive modeling techniques such as bayesian, connectionist, and logic-based models for intelligent problem-solving.	SDG 11	Sustainable Cities and Communities	Cognitive models enable intelligent urban systems, smart governance, transportation optimization, and sustainable community services.
CO3	Develop memory and language-based computational models for healthcare, education, and human-centered ai applications.	SDG 3	Good Health and Well-being	Cognitive models support healthcare analytics, clinical decision support, mental health monitoring, and personalized healthcare systems.
CO4	Build intelligent reasoning and decision-support systems using cognitive architectures for real-world applications.	SDG 13	Climate Action	Cognitive reasoning systems assist environmental monitoring, climate-risk assessment, sustainable resource utilization, and climate-aware decision-making.

QUANTUM COMPUTING

Class: B. Tech. VII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI703**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : identify the concepts of classical information processing, logic gates, reversible computation, and error handling techniques

CO2 : apply the principles of qubits, superposition, measurement, and quantum gate operations to construct basic quantum circuits

CO3 : analyze quantum states involving multiple qubits and evaluate the role of entanglement and error correction in quantum systems

CO4 : develop quantum programs using Qiskit/IBM Quantum tools to illustrate quantum communication protocols and algorithms

UNIT-I	**9 Hrs**

Classical Information and Computation: Bits, Coins, Dice, Encoding information, Physical bits, Binary representation

Logic Gates: Single-bit gates, Two-bit gates, Logic gates as physical circuits, Universal gates, Circuit simplification

Reversible Logic Gates: Reversible gates, Irreversible gates, Toffoli gate

Error Detection and Correction: Errors in physical devices, Error detection and error correction

UNIT-II	**9 Hrs**

One Quantum Bit: Introduction to qubits and superposition, Review of complex numbers for quantum computing

Quantum Measurement: Measurement in Z-basis, normalization, measurement in other bases. Bloch sphere mapping: Global and relative phases, spherical coordinates, Cartesian coordinates, Physical qubits

Quantum Gates: Classical reversible gates, Common one-qubit quantum gates, Quantum circuits and circuit diagrams

UNIT-III	**9 Hrs**

Multiple Quantum Bits and Entanglement: Entanglement mechanics, Connection to quantum computing

States and Measurement: Tensor product, Measuring individual qubits, Product states and entangled states

Quantum Gates: One-qubit and two-qubit quantum gates, Toffoli gate, No-cloning theorem, Definition of universal quantum gates, Components of a universal gate set, Examples of universal gate sets

Quantum Adders: Classical adder, Quantum sum, Quantum carry, Quantum ripple-carry adder

Introduction to Quantum Error Correction: Decoherence, Bit-flip code

UNIT-IV	**9 Hrs**

Quantum Programming and Quantum Applications: IBM Quantum services, Quantum Composer,

Quantum processor and simulator, Introduction to OpenQASM and Qiskit **Quantum Communication Protocols:** Superdense coding, Quantum teleportation, Quantum key distribution (BB84) **Introduction to Quantum Algorithms:** Deutsch algorithm, Grover's searching algorithm, Shor's factoring algorithm, Applications and future scope of quantum computing
Textbook(s): 1. Thomas G. Wong, *Introduction to Classical and Quantum Computing*, 1st edition, Rooted Grove Publications, 2022, Nebraska, USA. *(Chapters 1, 2, 4, 5, 6 and 7)*
Reference Book(s): 1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, 10th Anniversary edition, Cambridge University Press, 2010, United Kingdom. 2. David McMahon, *Quantum Computing Explained*, 1st edition, Wiley Publishing, 2008, United States of America. 3. Eric Johnston, Nic Harrigan, Mercedes Gimeno-Segovia, *Programming Quantum Computers*, 1st edition, O'Reilly Media, 2019, United States of America.
Web and Video link(s): https://nptel.ac.in/courses/106106232, *NPTEL: Introduction to Quantum Computing: Quantum Algorithms and Qiskit, by Prabha Mandayam, Anupama Ray, and Sheshashayee Raghunathan, Offered by Indian Institute of Technology Madras and IBM.*

Course Articulation Matrix (CAM):				**U24AI703 : QUANTUM COMPUTING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI703.1**	3	1	-	-	-	-	-	-	1	-	2	1	1
CO2	**U24AI703.2**	3	2	2	1	2	-	-	-	1	-	2	2	1
CO3	**U24AI703.3**	2	3	2	2	2	1	-	-	1	-	2	2	2
CO4	**U24AI703.4**	2	2	3	2	3	1	-	1	2	-	2	3	3
U24AI703		**2.5**	**2**	**2.33**	**1.67**	**2.33**	**1**	**-**	**1**	**1.25**	**-**	**2**	**2**	**1.75**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify the concepts of classical information processing, logic gates, reversible computation, and error handling techniques.	SDG 4	Quality Education	Understanding the foundational principles of computation equips students with advanced scientific knowledge and promotes lifelong learning in emerging technologies.
CO2	apply the principles of qubits, superposition, measurement, and quantum gate operations to construct basic quantum circuits.	SDG 9	Industry, Innovation and Infrastructure	Quantum computing is an emerging technological paradigm that drives innovation in next-generation computing infrastructure and advanced digital technologies.
CO3	analyze quantum states involving multiple qubits	SDG 11	Sustainable Cities and	Entanglement and quantum error correction underpin reliable, secure

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	and evaluate the role of entanglement and error correction in quantum systems.		Communities	quantum-networked infrastructure essential for resilient and sustainable smart-city systems.
CO4	develop quantum programs using Qiskit/IBM Quantum tools to illustrate quantum communication protocols and algorithms.	SDG 13	Climate Action	Quantum algorithms (Grover's, Shor's) accelerate optimization and materials/climate modelling, supporting AI-driven solutions for clean-energy and climate-resilient applications.

CLOUD COMPUTING

Class: B. Tech. VII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI704**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply cloud service models and deploy applications in public, private and hybrid cloud environments

CO2 : understand cloud architectures, virtualization concepts, containers and virtual machines

CO3 : implement cloud solutions using AWS, Azure, and GCP services such as compute, storage, networking and databases

CO4 : analyze cloud security, federated cloud models and advanced cloud technologies

UNIT-I	9 Hrs

Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environment, Computing platforms and technologies

Principles of Parallel and Distributive Computing: Eras of computing, Parallel vs. distributive computing, Elements of parallel computing, Elements of distributive computing, Technologies for distributive computing

UNIT-II	9 Hrs

Virtualization: Introductions, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples

Cloud Computing Architecture: Introduction, Cloud reference model, Types of cloud, Economics of the cloud, Open challenges

UNIT-III	9 Hrs

Data Intensive Computing: What is data intensive computing? Technologies for data intensive computing

Cloud Platform in Industry: Amazon web services, Google app engine, Microsoft Azure Cloud

Applications: Scientific applications: ECG analysis in the cloud, Business and consumer applications: CRM and ERP

UNIT-IV	9 Hrs

Advanced Topics in Cloud Computing: Federated clouds/Intercloud characterization and definition, Cloud federation stack, Aspects of interest, Technologies for cloud federation

Cloud Security: Security as a major concern for cloud users, Cloud security risks, Privacy and privacy impact assessment, Trust, Cloud data encryption, Security of database services, Operating system security, Virtual machine security, Security in virtualization, Security risks due to shared images

Textbook(s):
1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill, 2019, New Delhi. (Chapters 1, 2, 3, 4, 8, 10 and 11) 2. Dan C. Marinescu, *Cloud Computing Theory and Practice*, Elsevier, 2nd edition, 2018, Cambridge. (Chapter 9)
Reference Book(s):
1. Dr. Kumar Saurabh, Cloud Computing: Architecting Next-Gen Transformations Paradigms, Wiley India Private Limited, 4th edition, 2018, New Delhi. 2. Barrie Sosinsky, Cloud Computing Bible, Wiley Publications, 2011, Indiana. 3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, McGraw Hill, 2010, New York. 4. Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann, 3rd edition, 2013, USA.
Web and Video link(s):
https://onlinecourses.nptel.ac.in/noc21_cs14/preview ; *NPTEL Video Lecture on Cloud Computing by Prof. Soumya Kanti Ghosh, Professor of Computer Science and Engineering, IIT Kharagpur*

Course Articulation Matrix (CAM):				U24AI704: CLOUD COMPUTING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI704.1	2	2	2	1	2	1	1	1	1	-	1	2	2
CO2	U24AI704.2	2	2	2	1	2	1	1	1	1	-	1	2	2
CO3	U24AI704.3	2	2	2	2	2	1	1	1	1	-	1	2	2
CO4	U24AI704.4	2	2	2	2	2	1	1	1	1	-	1	2	2
U24AI704		2	2	2	1.5	2	1	1	1	1		1	2	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	apply cloud service models and deploy applications in public, private and hybrid cloud environments	SDG9	Industry, Innovation and Infrastructure	Cloud computing environments (public, private, hybrid) enable scalable IT infrastructure, supporting digital transformation, industrial growth, and innovation
CO2	understand cloud architectures, virtualization concepts, containers and virtual machines	SDG9	Industry, Innovation and Infrastructure	Cloud architectures and virtualization technologies improve resource utilization, system efficiency, and infrastructure development, forming the backbone of modern IT systems
CO3	implement cloud solutions using AWS, Azure, and GCP services such as compute, storage, networking and databases	SDG8	Decent Work and Economic Growth	Cloud platforms like AWS, Azure, and GCP create employment opportunities, support startups, and drive economic growth through digital services and automation

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	analyze cloud security, federated cloud models and advanced cloud technologies	SDG13	Climate Action	Efficient cloud resource management, federated systems, and secure data handling reduce energy consumption and carbon footprint, contributing to sustainable and eco-friendly computing

GENERATIVE AI AND LARGE LANGUAGE MODELS

Class: B. Tech. VII – Semester		**Branch:** CSE (AI&ML)	
Course Code	**U24AI705**	**Credits**	**3**
Hours/Week (L-T-P- E)	**2-1-0-3**	**CIE**	**60%**
Total Number of Teaching Hours	**36 Hrs**	**ESE**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : analyze generative AI foundations, including latent space representations, probabilistic modeling, and density estimation techniques for data generation

CO2 : apply and analyze deep generative models such as VAEs, GANs, and diffusion models for designing and evaluating generative systems

CO3 : analyze and apply transformer-based large language models, prompt engineering, and retrieval-augmented techniques for advanced text generation tasks

CO4 : apply, evaluate, and deploy large language model–based systems, including prompting, retrieval-augmented generation, and multimodal extensions, for real-world applications

UNIT-I	9 Hrs

Generative AI Overview: Data distributions and density estimation, Explicit vs Implicit generative models, Sampling vs inference, Applications: image synthesis, text generation, augmentation, Limitations and challenges

Latent Space & Representation Learning: Generative vs Discriminative modeling paradigms, Latent variables and embeddings, Continuous vs discrete latent spaces, Manifold hypothesis, Interpolation and latent arithmetic

Probabilistic Generative Modeling: Likelihood and maximum likelihood estimation (MLE), Approximate inference and variational inference, KL divergence and its interpretation, Evidence Lower Bound (ELBO) derivation (conceptual)

UNIT-II	9 Hrs

Variational Autoencoders (VAEs): Architecture and intuition, Reparameterization trick, KL regularization, Loss function, Applications

Generative Adversarial Networks (GANs): GAN framework, Generator-Discriminator training, Minimax objective, GAN training challenges, DCGAN, Conditional GANs, GAN Applications

Diffusion Models: Forward and reverse diffusion process, Noise prediction models, Diffusion sampling strategies, Comparison with VAEs and GANs, Stable Diffusion overview

UNIT-III	9 Hrs

Transformer Architecture: Self-attention, multi-head attention, Positional encoding, Encoder–decoder architecture, Decoder-only transformers, Causal language modeling, Masked language modeling, Scaling laws

LLMs: GPT-style models, Pretraining pieline, Fine-tuning pipeline, Tokenization, Embeddings, Emergent capabilities

Prompt Engineering: Zero-shot learning, few-shot learning, Instruction prompting, Chain-of-thought prompting, Prompt design strategies

Retrieval-Augmented Generation (RAG): RAG architecture, Embeddings for retrieval, vector search, Knowledge grounding, Hallucination reduction

UNIT-IV	9 Hrs

LLM-based Applications: Conversational AI, Dialogue systems (chatbots), Text summarization (extractive vs abstractive), Machine translation, Code generation, Program synthesis, Question answering systems, Content generation (reports, blogs, documentation)

LLM Adaptation and Deployment: Fine-tuning vs prompt tuning, LoRA, Adapters, Parameter-efficient tuning, Instruction tuning, Alignment methods, Inference optimization, Model serving, API-based deployment, Latency considerations, scalability considerations

Multimodal Extensions of LLMs: Vision-language models, LLM + vision integration, Text-to-image systems, Image captioning, Multimodal transformers, Search and accessibility, Limitations of multimodal LLMs

Textbook(s):

1. David Foster, *Generative Deep Learning*, O'Reilly Media, 2nd edition, 2023, California. *(Chapters 1 to 8)*
2. Sebastian Raschka, *Build a Large Language Model (From Scratch)*, Manning Publications, 1st edition, 2024, New York. *(Chapters 2 to 10)*
3. Jay Alammar and Maarten Grootendorst, *Hands-On Large Language Models*, Shroff, 1st edition, 2024. *(Chapters 1 to 9)*

Reference Book(s):

1. Daniel Jurafsky, James H. Martin, *Speech and Language Processing*, Pearson, 3rd edition, 2023, New Jersey.
2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, *Natural Language Processing with Transformers*, O'Reilly Media, 1st edition, 2022, California.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 2nd edition, 2019, California.

Web and Video link(s):

https://onlinecourses.swayam2.ac.in/e-learning/preview/imb24_mg116; *NPTEL Video Lectures on Generative AI and Large Language Models by Prof. Naveen Kumar Bhansali, IIM Bangalore.*

Course Articulation Matrix (CAM):				U24AI705 : GENERATIVE AI AND LARGE LANGUAGE MODELS										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI705.1	3	3	-	2	-	-	-	-	-	-	-	3	2
CO2	U24AI705.2	3	3	2	2	2	-	-	-	-	-	-	3	3
CO3	U24AI705.3	3	3	2	3	2	-	-	-	1	1	-	3	3
CO4	U24AI705.4	2	3	3	3	3	-	-	-	2	2	1	3	3
U24AI705		2.75	3	2.34	2.5	2.34	-	-	-	1.5	1.5	1	3	2.75
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze generative AI foundations, including latent space representations, probabilistic modeling, and density estimation techniques for data generation.	SDG4	Quality Education	Builds strong foundational knowledge in advanced AI concepts supporting higher education and skill development
CO2	apply and analyze deep generative models such as VAEs, GANs, and diffusion models for designing and evaluating generative systems.	SDG9	Industry, Innovation and Infrastructure	Enables development of innovative AI models used in modern industrial and technological applications.
CO3	analyze and apply transformer architectures, prompt engineering strategies, and retrieval-augmented techniques for advanced text generation tasks.	SDG9	Industry, Innovation and Infrastructure	Supports intelligent systems such as chatbots and NLP applications driving digital innovation.
CO4	apply and evaluate generative AI techniques for image, multimodal, and creative applications across diverse real-world domains.	SDG9	Industry, Innovation and Infrastructure	Enables deployment of scalable AI systems across industries.

CLOUD COMPUTING LABORATORY

Class: B. Tech. VII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI706**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : develop and run programs using basic cloud computing services such as compute, storage, databases, cloud operations, and serverless computing

CO2 : create and manage virtual machines and Virtual Private Cloud (VPC) networks using basic virtualization and networking concepts

CO3 : apply cloud networking concepts by designing subnets, configuring VPCs, routing, VPC peering, and virtual machine migration.

CO4 : develop cloud applications using containers, cloud databases, and cloud security practices

Experiment-1 (UNIT-I)

1. Develop a basic cloud setup and demonstrate usage of cloud services
2. Develop a program to Getting Started with Compute

Experiment-2 (UNIT-I)

1. Develop cloud storage services by creating and managing storage resources in a cloud environment
2. Develop database services in a cloud environment by creating and configuring a managed database instance

Experiment-3 (UNIT-I)

1. Develop AWS Management Console and Cloud Operations
2. Create Serverless Computing in Cloud

Experiment-4 (UNIT-II)

1. Develop AWS Management Console and EC2 instance access

Experiment-5 (UNIT-II)

1. Create a Virtual Machine
2. Compute Engine: Qwik Start

Experiment-6 (UNIT-II)

1. Create your own Virtual Private Cloud (VPC)
2. Create VPC Networking Fundamentals

Experiment-7 (UNIT-III)

1. Create public and private subnet
2. Develop a program to demonstrate Multiple VPC networks

Experiment-8 (UNIT-III)

1. Develop VPC network peering setup
2. Create Private Routing Table, associate subnet and add routing rules

Experiment-9 (UNIT-III)

1. Develop Conditional Virtual Machine Migration Between Nodes

Experiment-10 (UNIT-IV)

1. Deploy Windows Containers on Compute Engine

Experiment-11 (UNIT-IV)

1. Develop SQL for Big Query and Cloud SQL

Experiment-12 (UNIT-IV)

1. Develop Securing an application in cloud

Textbook(s):

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill, 2019, New Delhi. (Chapters 1 to 4, 8, 10 and 11)
2. Dan C. Marinescu, *Cloud Computing Theory and Practice*, Elsevier, 2nd edition, 2018, Cambridge. (Chapter 9)

Reference Book(s):

1. Dr. Kumar Saurabh, *Cloud Computing: Architecting Next-Gen Transformations Paradigms*, Wiley India Private Limited, 4th edition, 2018, New Delhi.
2. Barrie Sosinsky, *Cloud Computing Bible*, Wiley Publications, 2011, Indiana.
3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, *Cloud Computing: A Practical Approach*, McGraw Hill, 2010, New York.
4. Dan C. Marinescu, *Cloud Computing: Theory and Practice*, Morgan Kaufmann, 3rd edition, 2013, USA.

Laboratory Manual (for laboratory component):

1. *Cloud Computing Laboratory Manual,* Department of CSE (AI & ML), KITSW

Course Articulation Matrix (CAM):				**U24AI706: CLOUD COMPUTING LABORATORY**									
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI706.1**	2	2	2	2	2	-	-	1	1	-	2	2	1
CO2	**U24AI706.2**	2	2	2	2	2	-	-	1	1	-	2	2	1
CO3	**U24AI706.3**	2	2	2	2	2	-	-	1	1	-	2	2	1
CO4	**U24AI706.4**	2	2	2	2	2	-	-	1	1	-	2	2	1
U24AI706		2	2	2	2	2	-	-	1	1	-	2	2	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Develop and run programs using basic cloud computing services such as compute, storage, databases, cloud operations, and serverless computing	SDG9	Industry, Innovation and Infrastructure	Cloud computing fundamentals enable scalable and reliable IT infrastructure. Services like compute, storage, databases, and serverless architectures support digital transformation, foster innovation, and strengthen modern industrial ecosystems
CO2	Create and manage virtual machines and Virtual Private Cloud (VPC) networks using basic virtualization and networking concepts	SDG9	Industry, Innovation and Infrastructure	Virtualization and cloud networking improve infrastructure efficiency, optimize resource utilization, and support the development of robust, scalable systems essential for modern industries
CO3	Apply cloud networking concepts by designing subnets, configuring VPCs, routing, VPC peering, and virtual machine migration	SDG8	Decent Work and Economic Growth	Advanced cloud networking and migration techniques enhance system performance and availability, enabling businesses to scale operations, improve productivity, and support economic growth through digital services
CO4	Develop cloud applications using containers, cloud databases, and cloud security practices	SDG13	Climate Action	Efficient cloud deployments, containerization, and secure architectures reduce energy consumption and optimize resource usage, contributing to sustainable computing practices and lowering environmental impact

GENERATIVE AI AND LARGE LANGUAGE MODELS LABORATORY

Class: B. Tech. VII – Semester		**Branch:** CSE (AI&ML)	
Course Code:	**U24AI707**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: analyze and implement foundational concepts of Generative AI including latent space representations, embeddings, probabilistic modeling, and sampling techniques for synthetic data generation

CO2: design and evaluate deep generative models such as Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), and diffusion models for image and data generation tasks

CO3: apply transformer-based large language models, prompt engineering strategies, embeddings, and retrieval-augmented generation techniques for advanced natural language processing applications

CO4: develop, fine-tune, and deploy LLM-based and multimodal AI applications including conversational systems, summarization, question answering, parameter-efficient tuning, and vision-language integrations

Experiment-1 (UNIT-I)

1. Explore latent space representations and embedding visualization using dimensionality reduction techniques.

Experiment-2 (UNIT-I)

1. Implement probabilistic text generation and sampling techniques using temperature, top-k, and top-p sampling.

Experiment-3 (UNIT-II)

1. Build and train a Variational Autoencoder (VAE) for image generation or reconstruction.

Experiment-4 (UNIT-II)

1. Implement a Generative Adversarial Network (GAN/DCGAN) for synthetic image generation.

Experiment-5 (UNIT-II)

1. Demonstrate diffusion-based image generation using a pre-trained Stable Diffusion pipeline.

Experiment-6 (UNIT-III)

1. Study and implement text generation using pre-trained Generative AI/LLM APIs.

Experiment-7 (UNIT-III)

1. Implement prompt engineering techniques using zero-shot, one-shot, few-shot, and chain-of-thought prompting.

Experiment-8 (UNIT-III)

1. Build a Retrieval-Augmented Generation (RAG) system using embeddings and vector databases.

Experiment-9 (UNIT-IV)

1. Develop a conversational AI chatbot with context-aware multi-turn interaction.

Experiment-10 (UNIT-IV)

1. Implement text summarization and document question-answering using transformer-based LLMs.

Experiment-11 (UNIT-IV)

1. Perform parameter-efficient fine-tuning of a small language model using LoRA/adapters.

Experiment-12 (UNIT-IV)

1. Develop a multimodal Generative AI application integrating text and images (captioning or text-to-image generation).

Textbook(s):

1. David Foster, *Generative Deep Learning*, O'Reilly Media, 2nd edition, 2023, California. *(Chapters 1 to 8)*
2. Sebastian Raschka, *Build a Large Language Model (From Scratch)*, Manning Publications, 1st edition, 2024, New York. *(Chapters 2 to 10)*
3. Jay Alammar and Maarten Grootendorst, *Hands-On Large Language Models*, Shroff, 1st edition, 2024. *(Chapters 1 to 9)*

Reference Book(s):

1. Daniel Jurafsky, James H. Martin, *Speech and Language Processing*, Pearson, 3rd edition, 2023, New Jersey.
2. Lewis Tunstall, Leandro von Werra, Thomas Wolf, *Natural Language Processing with Transformers*, O'Reilly Media, 1st edition, 2022, California.
3. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media, 2nd edition, 2019, California.

Laboratory Manual:

1. *Generative AI & LLM Laboratory Manual,* Department of CSE (AI & ML), KITSW.

Course Articulation Matrix (CAM):				**U24AI707: GENERATIVE AI AND LARGE LANGUAGE MODELS LABORATORY**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI707.1**	3	3	-	2	-	-	-	-	-	-	-	3	2
CO2	**U24AI707.2**	3	3	2	2	2	-	-	-	-	-	-	3	3
CO3	**U24AI707.3**	3	3	2	3	2	-	-	-	1	1	-	3	3
CO4	**U24AI707.4**	2	3	3	3	3	-	-	-	2	2	1	3	3
U24AI707		2.75	3	2.34	2.5	2.34	-	-	-	1.5	1.5	1	3	2.75
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	analyze generative AI foundations, including latent space representations, probabilistic modeling, and density estimation techniques for data generation.	SDG4	Quality Education	Builds strong foundational knowledge in advanced AI concepts supporting higher education and skill development
CO2	apply and analyze deep generative models such as VAEs, GANs, and diffusion models for designing and evaluating generative systems.	SDG9	Industry, Innovation and Infrastructure	Enables development of innovative AI models used in modern industrial and technological applications.
CO3	analyze and apply transformer architectures, prompt engineering strategies, and retrieval-augmented techniques for advanced text generation tasks.	SDG9	Industry, Innovation and Infrastructure	Supports intelligent systems such as chatbots and NLP applications driving digital innovation.
CO4	apply and evaluate generative AI techniques for image, multimodal, and creative applications across diverse real-world domains.	SDG9	Industry, Innovation and Infrastructure	Enables deployment of scalable AI systems across industries.

INTERNSHIP EVALUATION

Class: B. Tech. VII – Semester		**Branch: CSE (AI & ML)**	
Course Code:	**U24AI708**	**Credits:**	**1**
Hours/Week (L-T-P- E):	**0-0-2-2**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience

CO2: apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems

CO3: exhibit professional skills including communication, teamwork, leadership, and lifelong learning

CO4: prepare internship reports and effectively communicate internship outcomes through presentations and viva-voce

Mandatory Internships:

1. The internships provide exposure to the real-world, get a feel for the work environment and how a professional workplace operates.
2. During the internship, students will experience a real-life engineering workplace and understand how their engineering and professional knowledge, skills, and qualities (KSQs) can be utilized in industry.
3. Students can learn, more importantly, how to apply the KSQs they have acquired during an internship to their future workplaces.
4. Students will also be able to demonstrate functioning engineering knowledge, both new & existing, and identify areas of further development for their future careers.
5. Internships give the student an opportunity to bridge theory and practice
6. Internships also provide students with the soft skills needed at workplace and leadership positions.
7. The internship guidelines are governed by the rules stipulated in the Institute's Internship Policy-2020 document.
8. The students shall have to undergo 6-8 weeks of mandatory internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs, IIITs& NITs.
9. HoD, along with Prof i/c internships, shall address students (*of 2nd, 4th and 6th semesters*) during last week of even semester of every academic year on the following
   a. creating awareness on mandatory 6-8 weeks internship by every student
   b. creating awareness on COs of internships
   c. KSQs the students would acquire doing internships
   d. expected internship outcomes
   e. available internship options, and organizations offering internships
   f. progressively completing 6-8 weeks internship by the end of 6th semester

summer, starting from 2nd semester summer break.

g. internship evaluation in 7th semester

h. internship report submission and oral presentation (through PPT) by student

10. Students undergoing the internship shall be required to submit their details to the department internship coordinators of the respective branches. He will coordinate all the internship activities of the students of that department.

11. Students have to submit a signed undertaking to the department internship coordinator for demonstrating honesty, integrity, professionalism and regular attendance at work place to add value to the organization where the internship is allotted. Students also have to uphold the professional image of our institute.

12. In case, a student is found to violate the internship rules and regulations, the student will have to produce a valid reason for the violation of internship rules. Without a valid reason, the student will be debarred from taking part in subsequent placement activities of the institute.

13. The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of one week internship at every stage.

14. The internship evaluation shall be done in the VII semester of study and hence the students shall complete the prescribed period of internship before start of VII semester (from end of II semester to commencement of VII semester).

15. The student learning assessment process (SLAP): The SLAP in internships shall include feedback from internship supervisor, submission of internship report on the complete internship and PPT presentation.

16. Internship Log Book: The activity journaling in a log book is very important for a successful internship.

   a. The internship supervisor identifies the work goals at the beginning of the internship

   b. Student has to maintain internship log book, where in the activities undertaken during internship and timely submission at periodic intervals are to be documented.

   c. At the conclusion of the internship, the supervisor shall specifically comment, in the internship log book, on whether the student met each of the work goals and to give evidence which describes the quality of work. For student, this also serves as a self- assessment.

   d. Internship log book *(with due signatures of the internship supervisor)* shall beconsidered for evaluation during presentation, i.e., number of planned meetings with internship supervisor and number attended by student

17. Meeting Cadence:

   i. **Regular meetings with internship supervisor:** Regular meetings with the internship supervisor to discuss work goals and review the status of activities undertaken are very essential. Student shall participate in discussions and take notes.

   ii. **Meeting Frequency:** The meeting cadence, *i.e., meeting frequency* shall be fixed inconsultation with the internship supervisor and accordingly student has to participate in discussions and take notes. Take signatures of internship supervisor as per the planned cadence in the internship log book.

18. The internship evaluation shall be done by ***department internship evaluation committee (*DIEC*)*** based on the submitted report by student and oral presentation.
19. There shall be only Continuous Internal Evaluation (CIE) for internship evaluation.
20. CIE for the Internship evaluation in VII semester shall be as below:

Internship evaluation	**Weightage**
A. **Internship Supervisor's Assessment** *(i) Feedback from the internship supervisor* *- on completion of internship assignment/work (20%)* *(ii) Feedback from the internship supervisor* *- on quality of work in internship assignment/work (10%)* *(iii) Feedback from the internship supervisor* *- internship log book (10%)* *(iv) Feedback from the internship supervisor* *- on attendance, punctuality and work hours (10%)* (For the case of 6-8 week internship done in more than one spell, it will be the average of all the internship supervisors' assessments)	**50%**
B. DIEC Assessment *(i) Internship duration (8 /12 weeks) (6/8 weeks online via NPTEL and 2/4 weeks offline) (10% / 10%)* *(ii) Internship Report (20%)* *(iii) Oral Presentation (with PPT) and viva voce (10%)* *(iv) SDG (5%)* *(v) Research Orientation (5%)*	**50%**
Total Weightage:	**100%**

Note: *It is mandatory for the student to appear for oral presentation (with PPT) and viva voce to qualify for course evaluation*

(a) Internship Report: Each student is required to submit a well-documented internship report (both *soft copy and softbound hard copy*) as per format specified by DIEC. In case of completing the 6-8 weeks internship in more than one organization, the student shall be required to prepare separate softbound internship reports signed by the internship supervisor (s)along with the seal(s) of the organization(s). The student shall submit two final softbound internship reports along with a soft copy, keeping all the certificate(s) issued by the internship supervisor(s) and all the individual internship reports cleared by the respective internship supervisor. Chapter 1 of the final internship report shall clearly describe the following, indicating an overall summary.

(i) **Internship(s) attended**: A table with name & address of organization, organization's vision and mission, internship weeks attended, internship period (exact dates attended), internship supervisor, head of the section and head of the organization.

(ii) **Duties/tasks during internship(s)**: Table describing name &address of organization, and the duties/tasks undertaken during internships. This indicates what opportunities and learning experiences the interns got to get hands-on experience on a wide range of KSQs of a professional engineer.

(iii) **Tangible outcomes of internship:** These are the lessons learnt from internship experience. The students have to describe in their own words what they learnt from the internship experience. The student has to describe what specific KSQs are acquired by him, with reference to the expected internship COs, after successful completion of internship(s). Finally, a table depicting systematic mapping of what they have learnt and the expected internship COs is to be shown.

*(iv) **Student feedback on internship:** To gather information on whether the internship was useful and gave practical experience in the chosen field of interest, and other learning, a well-defined feedback questionnaire (made available by the dept)with closed and open questions shall be kept in the report.*

*(v) **Pictures at the worksite:** Student has to keep, in the report, his working pictures at the worksite, discussing with the internship supervisor, the creative project he is working on, or an event he is attending for work, group photo of the team/section/department he worked with.*

(b) Anti-Plagiarism Check: The internship report should clear the plagiarism check as per theAnti-Plagiarism policy-2020 of the institute.

(c) Presentation: Each student should prepare PPT with informative slides and make an effective oral presentation before the DIEC as per the schedule notified by the department. The presentation shall compulsorily have slides on the points mentioned in (a)(i)-(v)

(d) It is mandatory for every student to *appear for oral presentation(with PPT) and viva-voce*, toqualify for internship evaluation

(e) A student shall register for supplementary examination for the internship evaluation in the following cases:

(i) absent for oral presentation and viva-voce

(ii) fails to submit the internship report in prescribed format

(iii) fails to fulfill the requirements of internship evaluation as per specified guidelines

(f) Supplementary examination for internship evaluation

(i) The CoE shall send the list of students registered for supplementary examination to the HoD concerned.

(ii) The DIEC, duly constituted by the HoD, shall conduct the internship evaluation supplementary exam and send the award list to the CoE within the stipulated time.

Course Articulation Matrix (CAM):		U24AI708: INTERNSHIP EVALUATION												
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI708.1	1	-	-	-	-	-	1	3	-	-	-	-	-
CO2	U24AI708.2	3	2	1	1	3	-	1	-	-	-	-	2	2
CO3	U24AI708.3	-	-	-	-	-	-	1	1	3	3	2	-	-
CO4	U24AI708.4	-	-	-	-	-	-	1	-	1	3	-	-	-
U24AI708		2	2	1	1	3	-	1	2	2	3	2	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Demonstrate understanding of professional practices, workplace ethics, and organizational functioning through internship experience	**SDG 4**	Quality Education	Industrial internship provides experiential learning in ECE domains such as Embedded Systems, IoT, VLSI, Communication Systems, Signal Processing, Artificial Intelligence, and Semiconductor Technologies. Students acquire practical skills, industry exposure, professional networking opportunities, and lifelong learning abilities, thereby strengthening quality technical education and employability.
CO2	Apply engineering knowledge and modern tools to perform assigned tasks and solve real-world problems	**SDG 11**	Sustainable Cities and Communities	Effective communication and collaboration are essential for multidisciplinary ECE projects such as smart city infrastructure, intelligent transportation systems, public safety networks, and digital communication platforms that contribute to sustainable and connected communities.
CO3	Exhibit professional skills including communication, teamwork, leadership, and lifelong learning	**SDG 9**	Industry, Innovation and Infrastructure	Application of ECE concepts to industrial problems through communication networks, embedded systems, IoT, VLSI, robotics, AI-enabled systems, and automation technologies promotes innovation, industrial modernization, and sustainable infrastructure development.
CO4	Prepare	**SDG 12**	Responsible	Professional ethics, quality assurance,

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	internship reports and effectively communicate internship outcomes through presentations and viva-voce		Consumption and Production	responsible technology deployment, resource optimization, and sustainable engineering practices in ECE industries encourage responsible production, efficient use of resources, and continuous improvement.

MAJOR PROJECT PHASE 1

Class: B. Tech. VII – Semester		Branch: CSE (AI & ML)	
Course Code:	**U24AI709**	**Credits:**	**4**
Hours/Week (L-T-P- E):	**0-0-8-8**	**CIE:**	**100%**
Total Number of Teaching Hours:	**-**	**ESE:**	

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1: review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex engineering problems (**Technical skills**)

CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (**Problem solving and critical thinking skills**)

CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (**Ethics and teamwork**)

CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (**Communication skills and life-long learning**)

1. Final Year Major Project work represents the culmination of study towards the B. Tech degree. ***Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems***. The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project work.

2. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.

3. **Team work:** Major project work is a team work.

   (i) The students of a project team shall work together to achieve a common objective.

   (ii) Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of a team having knowledge diversity, gender diversity, social and cultural diversity among its members.

4. **Two phases:** Major project work shall be carried out in two phases. Nearly 50 - 75% of the proposed work to be completed in 7th semester as *Phase-I* and the remaining work to be continued and completed in 8th semester as *Phase-II.*

5. Every student is expected to put approximately **72 hours of work** into the major project *phase-I* course over the 12 weeks of 7thsemester.

6. Major project work *Phase-I*: 7th semester

(i) The HoD shall constitute the ***department project evaluation committee (DPEC)*** with following composition

Department project evaluation committee (DPEC)	
HoD	Chairman
Senior Faculty	Convener
Coordinator(s)	Section-wise coordinator(s) *One coordinator for each section*
Three Faculty members	Section-wise faculty members *Three faculty members for each section representing various specializatio* *specializations will be covered including the coordinator's and Convene*

(ii) Major project allotment to students during last working week of 6th semester:

(a) **First / Second week of 6thSemester**: The process shall be initiated during the first / second week of 6thsemester by collecting project titles from the department faculty research groups, on offering innovative ideas/solutions for engineering problems.

(b) **MSE-I period of 6th Semester – Notifying project titles**: The finalized project titles shall be notified to students during the MSE-I period of 6th semester and student teams shall be allowed to exercise their options on titles that interest them.

(c) **Last working week of 6th Semester – Allotment of titles and supervisors to project teams**: The project title allotment to major project teams shall be completed before the last day of instruction of 6th semester

(d) **6th semester summer break - Literature review**: This 6th semester schedule enables students to complete literature review, preliminary simulations / investigations / experimentation during 6th semester summer break and *start the work from day-one in 7thsemester*

(e) **Registration Presentation - Notifying the tentative dates:** The major projectteams are expected to give registration presentation during second / third week from the commencement of 7th semester. The tentative dates for conducting the registration presentation shall be notified at the time of releasing the circular on allotted project title and project supervisors, as indicated in (c) above. This enables student teams to plan the work accordingly during summer break, to complete the literature review, preliminary simulations / investigations and get ready for informative, confident and comfortable presentations on their project work.

(iii) The convener DPEC shall notify, during MSE-I period of 6th semester, the list of implementable project titles offered by the faculty of different research groups of the department

(a) Project titles shall come with the following details to be made available to students on dept webpage and notice boards, facilitating students to select problems that interest them.

i. abstract
ii. deliverables / outcomes
iii. knowledge and skills required to complete the project
iv. resources required
v. one of the deliverables shall be writing a technical paper out of the major project work done for submission to a reputed non-predatory conference/non-paid peer reviewed journal

(iv) The major project teams, finalized by the convener DPEC, shall be allowed to exercise their options on the titles that interest them from the notified list

(v) **Project supervisor allotment**: The convener DPEC shall allot, during the last week of 6th semester, the faculty supervisors to all project teams

(a) The project supervisors shall

i. **define project objectives and expected deliverables**
ii. help the students plan their project work and timeline
iii. provide enough resources for successful project completion

(vi) The faculty supervisors are expected to provide guidance to project teams on

(a) *Engineering Knowledge - Applies engineering fundamentals, computing knowledge, and domain-specific concepts to solve the selected project problem*
(b) *Problem Analysis - Identifies, formulates, and analyzes a real-world engineering problem through literature review and requirement analysis*
(c) *Design/Development of Solutions - Designs and develops an innovative solution, system, or application that satisfies functional requirements while considering societal and environmental aspects*
(d) *Conduct Investigations of Complex Problems - Conducts experiments, collects and analyzes data, validates results, and draws meaningful conclusions using research methodologies*
(e) *Engineering Tool Usage - Uses modern engineering and IT tools, software frameworks, simulation tools, IDEs, databases, AI tools, and testing platforms for implementation*
(f) *The Engineer and the World - Evaluates the project's impact on society, sustainability, economy, health, safety, legal, cultural, and environmental aspects wherever applicable*
(g) *Ethics - Follows professional ethics by ensuring originality, respecting intellectual property, maintaining data privacy, and adhering to ethical standards*
(h) *Individual and Collaborative Team Work - Works effectively as an individual and as a member of a multidisciplinary project team, demonstrating leadership and collaboration*
(i) *Communication - Prepares project reports, technical documentation, presentations, demonstrations, and communicates project outcomes effectively*
(j) *Project Management and Finance - Plans project activities, schedules tasks, manages resources, estimates costs (where applicable), and completes milestones within timelines*
(k) *Life-Long Learning - Learns emerging technologies, research methodologies, and new tools independently to successfully complete the project*

(vii) The project supervisors are also expected to continuously emphasize and guide students on

(a) **Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increasea team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadenceand considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(b) **Project Log Book:** The activity journaling in project log book is veryimportant for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-I*, the supervisor shallspecifically comment, in the project log book, on whether the project team met each of the project work *phase-I* goals and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(c) **Following project timeline**: completing the tasks as planned in project timeline

(d) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work

(e) **Writing down whatever is done and making notes of whatever is read.** Writing down the procedures/models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, ***difficulties faced and how they were fixed*** are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on.
This information will be needed for the bibliography in your project report. On theother hand, documentinga report***on the spur of the moment*** would end up copying things from other sources resulting in a plagiarized document.

(f) **Good and sufficient literature review**: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing nearly 50 - 75% of the proposed work during phase-I

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented report in proper format, covering the progress made during Phase-I

(j) Consequences of plagiarism and use of anti-plagiarism software to detect plagiarism in documents

(k) Submission of major project phase-I report within acceptable plagiarism levels, as per the ***Anti-plagiarism policy-2020 of our institute***.

(l) **Video pitch:** Capturing short videos, photos, screenshots on experimentsconducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the work done during *phase-I.*

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained, and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to presenttheir project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) Phase**– I evaluation**: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Registration Presentation** *(during second / third week of 7th semester):* The Registration Presentation shall include a brief report and presentation focusing the identified problem, objective(s), literature review, identifying research gap in the literature, implementation of existing methods, proposed solution, and expected outcome(s).

i. The registration presentation shall invariably include the **project plan timeline** with actual start and finish dates– monthly/weekly project milestones/ timeline prepared in MS Excel or any other project management tool.

ii. **Project timeline** – *Weekly project milestones*: It's a compact and creative way to present a project plan. Identify the project intermediate goals and related tasks for completing each of those goals. Categorize tasks for each week. In the project timeline use different colors to the tasks for each week. Horizontal timeline layouts shall be preferred or any other layout of team's choice.

iii. Project teams shall create and present the following during registration presentation

1. *Complete project timeline*
2. *Phase-I project timeline*
3. *Phase-II project timeline*

iv. During every presentation, project teams shall compulsorily show the following as part of their presentation

1. *The slides on project timeline and*
2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*

v. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*) during presentations

(b) **Progress Presentation-I** *(during penultimate week of 7th semester):* At the end of first stage (7th semester), student teams shall be required present, before the DPEC, the progress made during phase-I and submit a well-documented report of work done for evaluation to the project coordinator

i. **Following project timeline**: The project timeline shall be meticulouslyfollowed and the tasks shall be completed as planned in the project timeline.

ii. Project teams shall compulsorily show the following as part of their progress presentation-I

1. The slides on project timeline and

2. A table showing targeted tasks as per timeline and whether tasks are accomplished?

iii. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*)

(c) **CIE schedule**: The convener DPEC shall release the complete schedule of CIE before start of 7th semester well in advance, so that student teams will complete the scheduled works and get ready with an informative, confident, and comfortable presentation for registration and progress presentations.

(ix) CIE for the Major project work Phase-I shall be as given below:

Major project work Phase-I Assessment *(7th semester)*

S.No	Assessment Component	Weightage (%)	CO Mapping	PO Mapping
1	Supervisor Assessment (Individual Contribution & Teamwork)	15	CO1, CO2	PO9, PO10
2	Problem Definition & Literature Review	5	CO1	PO1, PO2
3	Design & Methodology	5	CO2	PO3, PO4
4	Implementation & Working Model	15	CO2, CO3	PO3, PO5
5	Video Pitch	5	CO3, CO4	PO9, PO10
6	Project Report	15	CO1, CO4	PO1, PO8
7	Research Paper Writing	10	CO2, CO3	PO2, PO3
8	Oral Presentation & Viva Voce	20	CO3, CO4	PO9, PO10
9	Alignment with SDGs	10	CO3, CO4	PO6, PO7, PO8
	Total	100		

* *Students are advised to complete major part of the project in phase-I only*

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system, on the chosen work. The progress made in this shall be demonstrated during progress presentation-I at the end of *phase-I* and the completed working model/ process/software package/system before the DPEC as per the dates specified by DPEC at the end of *phase-II*.

(b) **Progress Report on *phase-I*:** Every project team shall be required to submit a well-documented progress report on dissertation phase-I as per format specified by DPEC.

a. **Tangible outcomes of *phase-I* in Conclusions - Chapter:** These are thelessons learnt from doing a project work. The students have to describe in their own words what they learnt from the *phase-I* project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of *phase-I* work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be presented in the conclusions chapter of *phase-I* report

(c) **Video pitch on *phase-I*:** Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I*. The project team shall present the produced video pitch during progress presentation-I. The produced video pitch should

a. be 3 to 5-minute-long video (no longer than 5 minutes)
b. be concise and to the point, on the problem and proposed solution
c. show project timeline and sample page of log book
d. highlight the progress made at various stages during *phase-I* project implementation with the help of short videos/photos / screenshots on experiments conducted, simulations carried out, part of prototype/ working model/process / software package/system being under development as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project
e. discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*
f. emphasize key points about *business idea, potential market for the proposed solution*

(x) It is mandatory for

(a) every student of the team to *appear for oral presentation and viva-voce*, as part of progress presentation -I to qualify for course evaluation
(b) every project team *to submit a well-documented progress report on major project work phase-I*, as part of progress presentation -I to qualify for course evaluation
(c) every project team to create and present a good video pitch on major project work*phase-I*, as part of progress presentation -I to qualify for course evaluation

(xi) A student shall register for supplementary examination for the Major project work*phase-I* in the following cases:

(a) He/she is absent for oral presentation and viva-voce as part of progress presentation-I
(b) The project team fails to submit the progress report on *Phase-I* in prescribedformat
(c) The project team fails to submit the video pitch on the progress made during the *phase-I* period.
(d) he/she fails to fulfill the requirements of Major project work *phase-I* evaluation as per specified guidelines

(xii) Supplementary examination for Major project work *phase-I*

(a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned
(b) The DPEC, duly constituted by the HoD, shall conduct Major Project Phase I

supplementary exam and send the award list to the CoE within the stipulated time

Major Project Phase-1 Evaluation Rubrics

S. No.	Assessment Component	Evaluation Criteria	Max Marks
1	Supervisor Assessment	Regularity & Interaction (5M)	15
		Understanding of Topic (5M)	
		Progress &Timely Completion(5M)	
2	Problem Definition & Literature Review	Problem Statement & Literature Survey (5M)	5
3	Design & Methodology	Methodology & System Design (5M)	5
4	Implementation & Working Model	Implementation (5M)	15
		Innovation & Testing (5M)	
		Performance & Usability (5M)	
5	Video Pitch	Visual Quality, Content Clarity & Delivery (5M)	5
6	Major Project Report	Structure, Format & Originality (5M)	15
		Technical Content (5M)	
		Clarity, Coherence & Writing (5M)	
7	Research Paper Writing	Structure, Organization & Academic Writing (5M)	10
		References, Citation & Originality (5M)	
8	Oral Presentation & Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
9	Alignment with SDGs	SDG Mapping & Impact Analysis (5M)	10
		Justification of SDG mapping, Clarity, Presentation & Originality (5M)	

Course Articulation Matrix (CAM):				U24AI709: MAJOR PROJECT PHASE I										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**U24AI709.1**	3	3	2	3	2	1	1	1	1	1	2	2	2
CO2	**U24AI709.2**	3	3	3	2	3	3	2	1	1	2	2	2	1
CO3	**U24AI709.3**	1	1	1	1	1	2	3	3	2	3	1	2	1
CO4	**U24AI709.4**	1	1	1	2	2	1	2	1	3	1	3	2	2
U24AI709		2	**2**	**1.75**	**2**	**2**	**1.75**	**2**	**1.5**	**1.75**	**175**	**2**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** **(The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)	**SDG 9**	Industry, Innovation and Infrastructure	Research gap identification, problem formulation, and development of innovative engineering solutions promote technological advancement, industrial innovation, and sustainable infrastructure development in ECE domains such as communication systems, IoT, VLSI, AI, and embedded systems.
CO2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	**SDG 12**	Responsible Consumption and Production	Engineering design considering resource optimization, environmental impact, sustainability, and efficient utilization of technology promotes responsible production and sustainable engineering practices.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member	**SDG 11**	Sustainable Cities and Communities	Effective teamwork, ethical engineering practices, leadership, and multidisciplinary collaboration facilitate the development of sustainable technological

CO–SDG Alignment Matrix				
CO	**CO Statement** **(The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	or leader of a multidisciplinary team.			solutions that improve societal well-being and community infrastructure.
		SDG3	Good Health and Well-Being	ECE projects related to biomedical instrumentation, healthcare IoT, telemedicine, wearable sensors, and assistive technologies contribute to improved healthcare services and quality of life.
CO4	Collate results, compare prototype performance with specifications, communicate findings through reports, posters, technical papers, presentations, and video pitches; engage in self-directed and lifelong learning.	**SDG 4**	Quality Education	Technical communication, dissemination of knowledge, professional documentation, and lifelong learning foster continuous education, skill enhancement, and knowledge sharing among engineering professionals.

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
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काकतीय प्रौद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
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(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

Semester -VIII Syllabi

VIII SEMESTER

S. No.	Category	Course Code	Course Title	Lectures / week				Credits
				L	T	P	E	C
1	PEC	U24AI801	Program Elective - III / MOOCs-III	2	1	-	3	3
2	PEC	U24AI802	Program Elective - IV / MOOCs-IV	2	1	-	3	3
3	PCC	U24AI803	Cybersecurity and Digital Forensics	2	1	-	3	3
5	ELC	U24AI804	Major Project, Phase – 2 / Industrial Internship - 2	-	-	12	12	6
			Total:	6	3	12	21	15
Additional Learning@:Maximum credits allowed for Honours/Minor				-	-	-	-	4
Total credits for Honours/Minor students:				-	-	-	-	19

Program Elective - III	
Course Code	**Course Title**
U24AI801A	Reinforcement Learning
U24AI801B	Block Chain Technologies
U24AI801C	Industrial IoT
U24AI801D	Data Visualization
U24AI801E	Responsible AI

Program Elective - IV	
Course Code	**Course Title**
U24AI802A	Bio-Inspired Algorithms
U24AI802B	Software Defined Networking
U24AI802C	Edge and Fog Computing
U24AI802D	Text and speech analytics
U24AI802E	Conversational AI

REINFORCEMENT LEARNING

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI801A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : solve Multi-armed Bandits problem in reinforcement learning algorithms

CO2 : apply Markov decision processes to define the interaction between a learning agent and its environment

CO3 : apply Monte Carlo Methods to model the probability of different outcomes in a process

CO4 : make use of Policy Gradient Methods for policy approximation and parameterization

UNIT-I	9 Hrs

Reinforcement Learning: Introduction, Examples, Elements of reinforcement learning, Limitations and scope, An extended example: Tic-Tac-Toe.

Multi-armed Bandits: A K-armed bandit problem, Action-value methods, Tracking a non- stationary problem, Optimistic initial values, Upper-confidence-bound action selection, Gradient bandit algorithms, Associative search (Contextual Bandits).

UNIT-II	9 Hrs

Markov Decision Processes: The Agent–environment interface, Goals and rewards, Returns and episodes, Policies and value functions, Optimality and approximation.

Dynamic Programming: Policy evaluation (Prediction), Policy improvement, Policy iteration, Value iteration, Asynchronous dynamic programming, Generalized policy iteration, Efficiency of dynamic programming

UNIT-III	9 Hrs

Monte Carlo Methods: Monte Carlo prediction, Monte Carlo estimation of action values, Monte Carlo control, On-policy & Off-policy Monte Carlo control and Incremental Implementation.

Temporal-Difference Learning: TD prediction, Optimality of TD (0), SARSA, Q-learning, R- learning, Games and after states.

UNIT-IV	9 Hrs

Function Approximation: Value prediction, Gradient descent methods, Linear function approximation, ANN based function approximation, Lazy learning, Instability issues.

Policy Gradient Methods: Non-associative learning – Reinforce algorithm, Exact gradient methods, Estimating gradients, Approximate policy gradient algorithms, Actor-critic methods.

Textbook(s):

1. Richard S. Sutton and Andrew G. Barto, *Reinforcement Learning*, 2nd edition, United Kingdom: MIT Press, 2018.

Reference Book(s):

1. Wiering, Marco, and Martijn Van Otterlo, *Reinforcement learning*, United States Springer, 2012.
2. Russell, Stuart. J and Peter Norvig, *Artificial intelligence: A modern approach*, United Kingdom: Pearson Education Limited, 2016.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc26_cs81/preview; *NPTEL Video Lecture on Reinforcement learning by* Prof. Balaraman Ravindran, *IIT Madras.*

Course Articulation Matrix (CAM):		**U24AI801A: REINFORCEMENT LEARNING**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI801A.1**	2	2	2	1	-	1	-	1	1	1	-	2	1
CO2	**U24AI801A.2**	2	2	1	2	2	-	-	1	1	1	-	2	1
CO3	**U24AI801A3**	2	2	1	3	2	-	-	1	1	1	-	2	1
CO4	**U24AI801A.4**	-	2	2	3	2	-	-	1	1	1	-	2	1
U24AI801A		2	2	1.5	2.25	2	1	-	1	1	1	-	2	1
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Solve Multi-armed Bandits problem in reinforcement learning algorithms	SDG9	Industry, Innovation and Infrastructure	Multi-armed bandit algorithms support intelligent decision-making and adaptive optimization in industrial automation, recommendation systems, and smart infrastructure applications.
CO2	Apply Markov decision processes to define the interaction between a learning agent and its environment	SDG11	Sustainable Cities and Communities	Markov Decision Processes enable smart resource management, traffic control, robotics, and autonomous systems that contribute to sustainable and intelligent urban environments.
CO3	Apply Monte Carlo Methods to model the probability of different outcomes in a process	SDG13	Climate Action	Monte Carlo methods help in environmental modeling, climate prediction, and uncertainty analysis for decision-making in climate-risk assessment and sustainable planning.
CO4	Make use of Policy Gradient Methods for policy approximation and parameterization	SDG3	Good Health and Well-being	Policy Gradient methods are widely used in healthcare robotics, adaptive treatment planning, and intelligent healthcare systems to improve patient care and decision support.

BLOCKCHAIN TECHNOLOGIES

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI801B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: apply specific blockchain architectures (Public, Private, Consortium) to solve trust and data-sharing challenges in industry-specific case studies

CO2: analyze the transaction lifecycle, network protocols, and cryptographic mechanics underlying Bitcoin and alternative cryptocurrencies

CO3: design and deploy secure Web3 applications by optimizing state mechanics, ledger account types, and gas execution costs

CO4: analyze and compare enterprise blockchain architectures, consensus protocols, and alternative ledger platforms to identify deployment trade-offs and research bottlenecks

UNIT-I	9 Hrs

Distributed Systems: Evolution of distributed systems

Distributed Ledger Technology (DLT): Concept of distributed ledgers

Introduction to Blockchain: History of blockchain, electronic cash, generic elements

Structure and Working of Blockchain: Blocks, hashing, linking, architecture, features, benefits and limitations

Types of Blockchain: Public, Private, Consortium, Tokenized, Token-less

Consensus Mechanisms: Introduction and types

UNIT-II	9 Hrs

Cryptographic Foundations of Bitcoin: Asymmetric (public key) cryptography, Public and private keys, Hash functions, Digital signatures (RSA and Elliptic Curve Concepts), Role of cryptography in Bitcoin, Digital Signature

Foundations of Bitcoin: Introduction to Bitcoin, Digital keys, addresses, and Basic cryptography (hashing, digital signatures), Bitcoin transactions (inputs, outputs, UTXO)

Blockchain and Network: Structure of blockchain (blocks, hashing, Merkle tree), Mining and Proof-of-Work, Bitcoin network (nodes, P2P architecture), Transaction lifecycle

Usage and Beyond Bitcoin: Wallets**,** Bitcoin payments and transaction fees, Limitations of Bitcoin

Bitcoin Clients and APIs: Bitcoin installation

Alternative Coins: Litecoin, Z cash

UNIT-III	9 Hrs

Smart Contracts Fundamentals: History of smart contracts, Definition and characteristics, Ricardian contracts, Applications of smart contracts

Ethereum: Introduction to Ethereum, Ethereum vs Bitcoin, Ethereum – bird's eye view, Ethereum accounts (EOA and Contract accounts), Ether, Gas and transaction fees

Ethereum Architecture and Network: Ethereum network and nodes, Components of Ethereum ecosystem, Transactions and state changes, Ethereum Virtual Machine (EVM)

Smart Contract Development: Programming languages for Ethereum, Solidity language (basics) Structure of smart contracts

Ethereum Development Environment: Test networks (public testnets), Setting up a private blockchain, Running and managing a private network, Development frameworks

Decentralized Applications and Web3: Introduction to DAO, Introduction to DApps, Web3 introduction

UNIT-IV	9 Hrs

Enterprise Blockchain Platforms: Introduction to enterprise blockchains, Overview of Hyperledger Hyperledger projects (Fabric – basic idea), Hyperledger architecture (reference model – concept)

Corda: Introduction to Corda, Architecture and components and Corda development environment

Introduction to alternative Blockchain Platforms: Ripple, Quorum, Multichain, Rootstock, BigchainDB, Storj, Tezos

Blockchain Applications and Industry Landscape: Real-world implementations of blockchain, Start-ups and industry adoption, Blockchain as a Service (BaaS), Employment opportunities in blockchain

Other challenges: Regulation, Dark side

Blockchain research: Smart contracts, Centralization issues, Limitations in cryptographic functions, Consensus algorithms, Scalability and Code obfuscation

Textbook(s):

1. Imran Bashir, *Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities to DeFi, NFTs and Web3*, Packt Publishing, 4th edition, 2023.

Reference Book(s):

1. Joseph Bonneau et al., *Blockchain Technology: From Theory to Practice*, Springer, 1st edition, 2022. *(Chapters 1–8)*
2. Brenn Hill, Samanyu Chopra, Paul Valencourt, *Blockchain Quick Reference*, Packt Publishing, 2018. *(Chapters 1–6)*
3. Kumar Saurabh, Ashutosh Saxena, *Blockchain Technology: Concepts and Applications*, Wiley, 2020. *(Chapters 1–9)*

Web and Video link(s):

https://in.video.search.yahoo.com/search/video?fr=mcafee&p=NPTEL+BLOCKCHAIN+TECHNOLOGIES+VIDEO&type=E210IN885G0#id=2&vid=0d4dce47729f5f0dccaa1ea877588f56&action=click

Course Articulation Matrix (CAM):		U24AI801B: BLOCKCHAIN TECHNOLOGIES												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI801B.1**	1	2	2	2	1	-	-	-	-	1	-	1	3
CO2	**U24AI801B.2**	3	3	2	2	1	-	-	-	-	1	-	2	3
CO3	**U24AI801B.3**	3	2	3	2	2	-	-	-	-	1	-	3	3
CO4	**U24AI801B.4**	1	2	3	2	1	-	-	-	-	1	-	2	3
U24AI801B		**2**	**2.25**	**2.5**	**2**	**1.25**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**3**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply specific blockchain architectures to solve trust and data-sharing challenges in industry case studies	SDG3	Good Health and Well-being	Applying consortium or private architectures to healthcare case studies ensures secure, tamper-proof medical record sharing and vaccine supply chain integrity
CO2	analyze the transaction lifecycle, network protocols, and cryptographic mechanics of cryptocurrencies	SDG8	Decent Work & Economic Growth	Analyzing secure decentralized networks prepares students for high-value engineering roles in the digital economy
CO3	design and deploy secure Web3 applications by optimizing state mechanics and gas execution costs.	SDG13	Climate Action	Minimizing smart contract gas execution costs reduces computational load across global validator nodes. Lower compute requirements directly lower the energy footprint and carbon emissions of distributed systems
CO4	analyze and compare enterprise blockchain architectures, consensus protocols, and alternative ledger platforms.	SDG9	Industry, Innovation, & Infrastructure	Analyzing enterprise frameworks helps build resilient industrial infrastructure. Identifying deployment trade-offs allows businesses to build highly scalable, compliant financial platforms that boost economic efficiency

INDUSTRIAL IoT

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI801C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : identify the Industry 4.0 drivers, industrial sensing technologies, and IIoT business and reference architectures for industrial applications

CO2 : apply off-site and on-site technologies, industrial communication protocols, and data transmission mechanisms to Industrial IoT systems

CO3 : apply industrial data acquisition techniques, machine learning, and data science methods to develop Industrial IoT applications

CO4 : analyze Industrial IoT concepts to design solutions for real-world applications such as healthcare, predictive maintenance, and smart manufacturing

UNIT-I	9 Hrs

Industry 4.0: Introduction, Design requirements, Drivers, Sustainability assessment, Smart business perspective, Cyber security, Impact of Industry 4.0

Industrial Internet of Things (IIoT): Introduction, Industrial internet systems, Industrial sensing, Industrial processes

Business Model and Reference Architecture of IoT & IIoT: Introduction, Business models of IoT & IIoT, Reference architecture of IoT & IIOT, IIRA, Key performance indicators for occupational safety and health, RAMI 4.0

UNIT-II	9 Hrs

Off-site Technologies: Introduction, Cloud computing, Fog computing

On-site Technologies: Introduction, Augmented Reality, Virtual Reality, Big data and advanced analytics, Smart factories, Lean manufacturing systems

Industrial Data Transmission: Introduction, Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-link, Modbus, Batibus, DigitalSTROM, Controler area network, DeviceNet, LonWorks, ISA 100.11a, Wireless HART, LoRa, LoRaWAN, Recent and upcoming technologies

UNIT-III	9 Hrs

Industrial Data Acquisition: Distributed control system, PLC, SCADA

IIoT Analytics: Necessity of analytics, IIOT analytics

Machine Learning & Data Science applications in the Industry: Categorization and applications of ML in industry, Data science in industry, Deep Learning and its applications in industry

Case Studies: Inventory management and quality control, Manufacturing industry, Automotive industry, Mining industry

UNIT-IV	9 Hrs

Case Studies: IoT enabled Smart traffic control system, IoT framework for health care environment, IoT drainage system for detection of drainage pipes, Predictive maintenance

for retail machine industries, Integrating ANN and IoT for predictive maintenance for machine industry, Society 4.0, Society 5.0
Textbook(s): 1. Sudip Misra, Chandan Roy, Anandarup Mukharjee, *Introduction to Industrial Internet of Things and Industry 4.0*, 1st edition, Oxno: CRC Press, Taylor & Francis group, 2021. *(Chapters: 1-10)* 2. A. Suresh, Malarvizhi Nandagopal, Pethuru Raj, E.A. Neeba, Jenn-Wei Lin, *Industrial IoT Application Architecture and Use Cases*, 1st edition, Suite: CRC press, Taylor & Francis group, 2020. *(Chapter: 11)*
Reference Book(s): 1. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Thailand: Apress, 2016.
Web and Video link(s): https://onlinecourses.nptel.ac.in/noc26_cs38/preview; *NPTEL Video Lecture on Introduction To Industry 4.0 And Industrial Internet Of Things by Prof. Sudip Misra, Professor of CSE, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI801C: INDUSTRIAL IoT**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI801C.1**	2	2	1	1	1	-	-	1	1	1	1	2	2
CO2	**U24AI801C.2**	2	2	2	2	2	-	-	1	1	1	2	2	2
CO3	**U24AI801C.3**	2	2	3	2	2	-	-	1	1	1	2	2	2
CO4	**U24AI801C.4**	2	2	3	3	2	-	-	1	1	2	2	2	2
U24AI801C		2	2	2.25	2	1.75	-	-	1	1	1.25	1.75	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify the Industry 4.0 drivers, industrial sensing technologies, and IIoT business and reference architectures for industrial applications	SDG9	Industry, Innovation and Infrastructure	Understanding Industry 4.0 drivers, industrial sensing, and IIoT architectures provides the foundation for developing innovative industrial systems and resilient digital infrastructure, supporting sustainable industrialization
CO2	apply off-site and on-site technologies, industrial communication protocols, and data transmission mechanisms to Industrial IoT systems	SDG9	Industry, Innovation and Infrastructure	Applying cloud, fog computing, industrial communication protocols, and networking technologies enhances industrial connectivity, automation, and innovation, contributing to modern industrial infrastructure

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO3	apply industrial data acquisition techniques, machine learning, and data science methods to develop Industrial IoT applications	SDG 8	Decent Work and Economic Growth	Applying data acquisition, machine learning, and analytics improves industrial productivity, operational efficiency, and intelligent decision-making, promoting sustainable economic growth and productive employment
CO4	analyze Industrial IoT concepts to design solutions for real-world applications such as healthcare, predictive maintenance, and smart manufacturing	SDG11	Sustainable Cities and Communities	Analyzing IIoT-based solutions for healthcare, predictive maintenance, and smart manufacturing supports the development of sustainable infrastructure, efficient public services, and smart communities

DATA VISUALIZATION

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI801D**	**Credits:**	**3**
Hours/Week (L-T-P-E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs):

After completion of this course, the students should be able to,

CO1 : identify the basic and advanced techniques of data visualization, types of data and data processing

CO2 : apply visualization techniques for representing the spatial and geospatial data

CO3 : apply visualization techniques for representing the time-oriented and unstructured data

CO4 : analyze text and document visualization techniques

UNIT-I	**9 Hrs**

Data Visualization: Visualization functionalities, Importance the difference between visualization and computer graphics, The visualization process, The scatter plot

Data Foundations: Types of data, Data preprocessing, Visualization foundations, The eight visual variables, Taxonomies

UNIT-II	**9 Hrs**

Visualization Techniques for Spatial Data: One-dimensional data, Two-dimensional data, Three-dimensional data, Visualizing volume data, Dynamic data

Visualization Techniques for Geospatial Data: Visualizing geospatial data, Map projections, Visualization of point data, Line data

UNIT-III	**9 Hrs**

Visualization Techniques for Time-Oriented Data: Introduction, Definitions, characterizing time-oriented data, Relating data and time, Visualizing time-oriented data, Categorization

Visualization Techniques for Trees, Graphs, and Networks: Displaying hierarchical structures, Displaying arbitrary graphs, Networks, Node-link graphs, Matrix representations for graphs

UNIT-IV	**9 Hrs**

Text and Document Visualization: Levels of text representations, The Vector space model, Single document and Document collection visualizations

Image Visualization: Image Data Representation, Image Processing and Visualization, Basic Imaging Algorithms, Shape Representation and Analysis, Conclusion

Visualization Systems: Systems based on data type, Systems based on analysis type, Toolkits, Libraries, Research directions in visualization

Textbook(s):

1. Matthew O. Ward, Georges Grinstein, Daniel Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications*, 2nd edition, Boca Raton: A K Peters/CRC Press, 2015.
2. Alexandru C. Telea, *Data Visualization: Principles and Practice*, 2nd edition, Boca Raton: CRC Press, 2015.

Reference Book(s):

1. Claus Wilke, *Fundamentals of Data Visualization*: A Primer on Making Informative and Compelling Figures, 1st edition, Sebastopol: O'Reilly Media Inc, 2019.
2. Kristen Sosulski, *Data Visualization Made Simple: Insights into Becoming Visual*, 2nd edition, Oxon: Routledge, 2015.
3. Ben Fry, *Visualizing Data*, 1st edition, Sebastopol: O'Reilly Media Inc, 2008.

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc25_mg154/preview; *NPTEL Video Lecture on Advanced R Programming for Data Analytics in Business By Prof. Abhinava Tripathi, Faculty of Finance and Accounting at IME, IIT Kharagpur.*

Course Articulation Matrix (CAM):				**U24AI801D : DATA VISUALIZATION**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI801D.1**	2	2	2	2	1	-	1	-	1	2	1	1	2
CO2	**U24AI801D.2**	2	2	2	1	1	-	1	-	1	3	-	1	2
CO3	**U24AI801D.3**	2	2	2	2	1	-	-	-	1	2	1	1	2
CO4	**U24AI801D.4**	2	2	2	2	1	-	-	-	1	2	1	1	2
U24AI801D		2	2	2	1.75	1	-	1	-	1	2.25	1	1	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	identify the basic and advanced techniques of data visualization, types of data and data processing	SDG4	Quality Education	Builds analytical thinking, digital literacy, and foundational visualization skills essential for modern education and data-driven learning.
CO2	apply visualization techniques for representing the spatial and geospatial data	SDG11	Sustainable Cities and Communities	Spatial and geospatial visualizations support urban planning, environmental monitoring, transportation management, and sustainable city development.
CO3	apply visualization techniques for representing the time-oriented and unstructured data	SDG9	Industry, Innovation and Infrastructure	Advanced visualization of temporal and network data helps industries and organizations improve infrastructure systems, communication networks, and innovation-driven decision-making.
CO4	analyze text and document visualization techniques and visualization systems using modern tools and libraries	SDG16	Peace, Justice and Strong Institutions	Effective visualization systems and ethical information representation improve transparency, accessibility of information, and informed decision-making in institutions and organizations.

RESPONSIBLE AI

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI801E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: understand AI technologies, ethics, societal impacts, and risks, and apply responsible AI governance to build trustworthy, human-centered, and socially beneficial systems

CO2: analyse and apply ethical, legal, fairness, and accountability principles in Artificial Intelligence systems to ensure transparent, non-discriminatory, and responsible AI deployment

CO3: ensure responsible AI governance by applying data protection, accountability, transparency, regulatory compliance, and ethical practices across AI systems in all industries

CO4: apply ethical, legal, and governance principles for responsible use of Artificial Intelligence in healthcare, neurotechnology, security, and armed conflict to ensure human rights, safety, and accountability

UNIT-I	9 Hrs

Foundations of Responsible AI: Artificial Intelligence: Key Technologies and Opportunities, Automating Supervision of AI Delegates, Artificial Moral Agents: Conceptual Issues and Ethical Controversy, Risk Imposition by Artificial Agents: The Moral Proxy Problem, Artificial Intelligence and Its Integration into the Human Lifeworld

Current and Future Approaches to AI Governance: Artificial Intelligence and the Past, Present, and Future of Democracy, The New Regulation of the European Union on Artificial Intelligence: Fuzzy Ethics Diffuse into Domestic Law and Sideline International Law, Fostering the Common Good: An Adaptive Approach Regulating High-Risk AI-Driven Products and Services

UNIT-II	9 Hrs

Responsible AI Liability Schemes: Liability for Artificial Intelligence: The Need to Address Both Safety Risks and Fundamental Rights Risks, forward to the Past: A Critical Evaluation of the European Approach to Artificial Intelligence in Private International Law

Fairness and Non-discrimination in AI Systems: Differences That Make a Difference: Computational Profiling and Fairness to Individuals, Discriminatory AI and the Law: Legal Standards for Algorithmic Profiling

UNIT-III	9 Hrs

Responsible Data Governance: Artificial Intelligence and the Right to Data Protection, Artificial Intelligence as a Challenge for Data Protection Law: And Vice Versa, Data Governance and Trust: Lessons from South Korean Experiences Coping with COVID-19

Responsible Corporate Governance of AI Systems: From Corporate Governance to Algorithm Governance: Artificial Intelligence as a Challenge for Corporations and Their Executives, Autonomation and Antitrust: On the Construal of the Cartel Prohibition in the Light of Algorithmic Collusion, Artificial Intelligence in Financial Services: New Risks and the Need for More Regulation

UNIT-IV	9 Hrs

Responsible AI Healthcare and Neurotechnology Governance: Medical AI: Key Elements

at the International Level, "Hey Siri, How Am I Doing?": Legal Challenges for Artificial Intelligence Alter Egos in Healthcare, 'Neurorights': A Human Rights–Based Approach for Governing Neuro technologies, AI-Supported Brain–Computer Interfaces and the Emergence of 'Cyberbilities' **Responsible AI for Security Applications and in Armed Conflict:** Artificial Intelligence, Law, and National Security, Morally Repugnant Weaponry? Ethical Responses to the Prospect of Autonomous Weapons, On 'Responsible AI' in War: Exploring Preconditions for Respecting International Law in Armed Conflict
Textbook(s): 1. Silja Voeneky, Philipp Kellmeyer, Oliver Mueller, Wolfram Burgard, *The Cambridge Handbook of Responsible Artificial Intelligence: Interdisciplinary Perspectives*, Cambridge University Press, 2022.
Reference Book(s): 1. Virginia Dignum, *Responsible Artificial Intelligence*: *How to Develop and Use AI in a Responsible Way*, Springer Nature, 2019. 2. Christoph Molnar, *Interpretable Machine Learning*, Lulu Publication, 1st Edition, 2019. 3. Mark Coeckelbergh, *AI Ethics, MIT Press*, 2020. 4. Stuart Russell, Human Compatible: *Artificial Intelligence and the Problem of Control*, Viking Publications, 2019. 5. Lu, Q., Zhu, L., Whittle, J., & Xu, X., *Responsible AI: Best Practices for Creating Trustworthy AI Systems*, Addison Wesley Professional, 2023.
Web and Video link(s): https:// nptel.ac.in/courses/106106472; *NPTEL Video Lecture on NOC: Responsible & Safe AI Systems by Prof. Ponnurangam Kumaraguru, Prof. Balaraman Ravindran, Prof. Arun Rajkumar, Professor of* IIITH & IITM

Course Articulation Matrix (CAM):				**U24AI801E: RESPONSIBLE AI**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI801E.1**	3	2	2	2	1	3	3	2	2	1	1	2	2
CO2	**U24AI801E.2**	2	3	2	2	1	3	3	2	2	1	1	2	2
CO3	**U24AI801E.3**	2	2	2	2	2	3	3	2	2	2	2	2	2
CO4	**U24AI801E.4**	2	2	3	2	2	3	3	2	2	1	1	2	2
U24AI801E		2.25	2.25	2.25	2	1.5	3	3	2	2	1.25	1.25	2	2
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	understand AI technologies, ethics, societal impacts, and risks, and apply responsible AI governance to build trustworthy, human-	SDG16	Peace, Justice and Strong Institutions	as it focuses on responsible AI governance, ethical decision-making, regulatory frameworks (e.g., EU AI Act), risk accountability, and the integration of AI into democratic and societal institutions

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	centered, and socially beneficial systems.			to ensure transparent, fair, and trustworthy AI systems
CO2	analyse and apply ethical, legal, fairness, and accountability principles in Artificial Intelligence systems to ensure transparent, non-discriminatory, and responsible AI deployment.	SDG10	Reduced Inequalities	by addressing fairness, accountability, transparency, and non-discrimination in Artificial Intelligence systems to ensure inclusive and equitable digital technologies
CO3	ensure responsible AI governance by applying data protection, accountability, transparency, regulatory compliance, and ethical practices across AI systems in all industries.	SDG9	Industry, Innovation and Infrastructure	by promoting responsible AI governance, secure data infrastructures, ethical digital innovation, and regulatory frameworks necessary for sustainable industrial and technological development
CO4	apply ethical, legal, and governance principles for responsible use of Artificial Intelligence in healthcare, neurotechnology, security, and armed conflict to ensure human rights, safety, and accountability.	SDG3	Good Health and well being	(Good Health and Well-Being) due to its emphasis on responsible AI in healthcare, neurotechnology governance, medical ethics, and human-centered AI systems. It also partially supports SDG 9 (Industry, Innovation and Infrastructure) through innovation in AI and neurotechnologies, and SDG 16 through ethical AI governance and international law in security applications

BIO-INSPIRED ALGORITHMS

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI802A**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: explain principles of bio-inspired computing and natural intelligence.

CO2: analyse behaviour and working principles of modern optimization algorithms

CO3: apply bio-inspired algorithms for optimization and machine learning tasks

CO4: evaluate algorithm performance for real-world engineering and AI applications

UNIT-I	9 Hrs

Nature inspired Optimization Algorithms: Classical Optimization Methods, Nature inspired Algorithms, Particle Swarm Optimization, Differential Evolution, Bee Colony Optimization, Fish School Search Optimization, Cuckoo Search Algorithm, Firefly Algorithm, Bat Algorithm.

UNIT-II	9 Hrs

Optimization Algorithms: Flower Pollination Algorithm, Grey Wolf Optimization (GWO) Algorithm, Elephant Search Algorithm (ESA), Crow Search Algorithm, Raven Roosting Algorithm, Applications, Conclusion, Cat Swarm Optimization (CSO), Whale Optimization Algorithm (WOA), Artificial Algae Algorithm (AAA), Applications in Optimization Problems.

UNIT-III	9 Hrs

Multi Objective algorithms: Teaching Learning Based Optimization, Chicken Swarm Optimization Algorithm (CSOA), Moth Flame Optimization (MFO), Hunting and Social Behavior-Based Optimization, Dragonfly Algorithm.

UNIT-IV	9 Hrs

Modern Optimization Algorithms: Harris Hawks Optimization (HHO), Salp Swarm Algorithm (SSA), Sparrow Search Algorithm (SSA), Aquila Optimizer (AO), Gorilla Troops Optimizer (GTO), Artificial Protozoa Optimizer (APO), Goat Optimization Algorithm (GOA), Octopus Optimization Algorithm, Schrödinger Optimizer.

Textbook(s):

1. Vasuki A, *Nature-Inspired Optimization Algorithms*, Chapman and Hall CRC, 1st edition, 2020.
2. Altaf Q. H. Badar, *Evolutionary Optimization Algorithms*, CRC Press, 1st edition, 2021.

Reference Book(S):

1. A.E. Eiben, J.E. Smith, *Introduction to Evolutionary Computing*, Springer, 2nd edition, 2015, Heidelberg New York.
2. *Bio-inspired computing: Algorithms review, deep analysis, and the scope of applications*, Future Computing and Informatics Journal, Volume 3, Issue 2, December 2018, Pages 231-246. https://www.sciencedirect.com/science/article/pii/S2314728818300631
3. Jianyong Qiao, Xinchao Zhao, Linqiang Pan, Xingquan Zuo, Xingyi Zhang, Qingfu Zhang, Shanguo Huang, *Bio-inspired Computing: Theories and Applications,* 13th International Conference, BIC-TA 2018, Beijing, China, November 2–4, 2018, Proceedings, Part II.

Web and Video link(s):
https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_me43
https://nptel.ac.in/courses/112103301

Course Articulation Matrix (CAM): U24AI802A: BIO-INSPIRED ALGORITHMS															
Course Outcomes		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**U24AI802A**.1	1	2	1	1	1	-	1	1	1	1	1	1	1	1
CO2	**U24AI802A**.2	1	2	2	2	1	-	1	1	1	1	1	1	1	1
CO3	**U24AI802A**.3	1	2	2	2	1	-	1	1	2	1	1	1	1	1
CO4	**U24AI802A**.4	1	2	1	1	1	-	1	1	2	1	1	1	1	1
U24AI802A		**1**	**2**	**1.5**	**1.5**	**1**	**-**	**1**	**1**	**1.5**	**1**	**1**	**1**	**1**	**1**
3 – HIGH, 2 – MEDIUM, 1 - LOW															

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	explain principles of bio-inspired computing and natural intelligence.	SDG 4	Quality Education	Provide the knowledge about the principles of bio inspired computing and natural intelligence to improve the quality of understanding and study by observing nature and derive the solutions.
CO2	analyse behavior and working principles of modern optimization algorithms.	SDG 9	Industry, Innovation and Infrastructure	The algorithms developed can be used for helping the industry to improve the infrastructure by optimizing various situations with a large number of parameters.
CO3	apply bio-inspired algorithms for optimization and machine learning tasks	SDG 11	Sustainable Smart Systems	The solutions developed are useful in finding the improved infrastructure in the smart city environment like self- driving cars with swarm intelligence solutions.
CO4	Evaluate algorithm performance for real-world engineering and AI applications.	SDG 13	Climate Action through Intelligent Optimization	Smart applications like Smart Greenhouse improve sustainable agriculture (SDG 11)

SOFTWARE DEFINED NETWORKING

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI802B**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : classify SDN architecture, layers, and programmable networking concepts

CO2 : analyze OpenFlow operations and SDN controller functionalities

CO3 : develop virtualized and programmable network configurations using SDN tools and frameworks.

CO4 : examine SDN applications in cloud computing, security, IoT, and data center environments

UNIT-I	**9 Hrs**

Introduction to Software Defined Networking: Evolution of computer networks, Limitations of traditional networking, Introduction to SDN, Characteristics and benefits of SDN, SDN architecture, control plane and data plane separation, SDN layers and components, SDN versus traditional networking, Applications of SDN

UNIT-II	**9 Hrs**

OpenFlow and SDN Controllers: OpenFlow protocol fundamentals, OpenFlow switch architecture, Flow tables and packet processing, OpenFlow message types

SDN Controllers: NOX controller, POX controller, OpenDaylight controller, Ryu controller

UNIT-III	**9 Hrs**

Network Virtualization and Programmable Networks: Network virtualization concepts, Virtual switches, Overlay networks, Network Function Virtualization (NFV), Introduction to SDN simulation using Mininet

Programmable Network Management: APIs and northbound/southbound interfaces, SDN security challenges

UNIT-IV	**9 Hrs**

SDN Applications: SDN in cloud computing, SDN in data centers, Software Defined WAN (SD-WAN), SDN-based network security, SDN in IoT networks, Traffic engineering using SDN

Emerging Trends in SDN: Intelligent SDN applications, Emerging trends in SDN

Textbook(s):

1. Thomas D. Nadeau and Ken Gray, *SDN: Software Defined Networks*, 1st edition, O'Reilly Media, 2013, Sebastopol. *(Chapters 1 to 6)*
2. Paul Goransson, Chuck Black, and Timothy Culver, *Software Defined Networks: A Comprehensive Approach*, 2nd edition, Morgan Kaufmann Publications, 2016, Burlington. *(Chapters 1 to 5, 7 to 10)*

Reference Book(S):

1. Siamak Azodolmolky, *Software Defined Networking with OpenFlow*, 2nd edition, Packet

Publishing, 2017, Birmingham.
2. Matt Oswalt, Christian Adell, Scott S. Lowe, and Jason Edelman, *Network Programmability and Automation*, 2nd edition, O'Reilly Media, 2023, Sebastopol.
3. Khaled Abuelenain, Jeff Doyle, Anton Karneliuk, and Vinit Jain, *Network Programmability and Automation Fundamentals*, 1st edition, Cisco Press, 2021, Indianapolis.
4. Fei Hu (Ed.), *Network Innovation through OpenFlow and SDN: Principles and Design*, 1st edition, CRC Press, 2014, Boca Raton.

Web and Video link(s):

https://www.youtube.com/watch?v=CaukSKg_sI0.*NPTEL Video Lecture on Software Defined Networking – I (Basics) by Prof. Sandip Chakraborty and Prof. Soumya Kanti Ghosh, IIT Kharagpur*

Course Articulation Matrix (CAM):				**U24AI802B: SOFTWARE DEFINED NETWORKING**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI802B.1**	2	2	1	-	1	-	-	-	1	-	-	2	1
CO2	**U24AI802B.2**	2	3	2	2	2	-	-	-	1	-	1	2	2
CO3	**U24AI802B.3**	2	2	3	2	3	1	-	-	1	-	1	3	2
CO4	**U24AI802B.4**	2	3	2	2	2	1	1	1	1	-	2	2	3
U24AI802B		2	2.5	2	2	2	1	1	1	1	-	1.33	2.25	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	classify SDN architecture, layers, and programmable networking concepts	SDG9	Industry, Innovation and Infrastructure	SDN architecture and programmable networking support modern digital infrastructure and innovation in communication technologies.
CO2	analyze OpenFlow operations and SDN controller functionalities	SDG9	Industry, Innovation and Infrastructure	OpenFlow and SDN controllers enable scalable, programmable, and efficient network infrastructure for modern industries and digital systems.
CO3	develop virtualized and programmable network configurations using SDN tools and frameworks	SDG11	Sustainable Cities and Communities	Network virtualization and programmable networking improve efficient resource utilization and support sustainable smart city communication infrastructure.
CO4	examine SDN applications in cloud computing, security, IoT, and data center environments	SDG13	Climate Action	Intelligent and optimized SDN-based infrastructures improve energy efficiency and sustainable resource utilization in cloud and networking environments.

EDGE AND FOG COMPUTING

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI802C**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand the foundations of fog and edge computing networks and different architectures

CO2 : design fog and edge computing based systems and applications using reference architectures

CO3 : understand and apply data collection, analysis, decision making and learning methodologies over the edge for different applications

CO4 : apply optimization techniques for edge and fog computing

UNIT-I	9 Hrs

Foundations: Introduction to IoT, Fog and edge computing, Hierarchy of fog and edge computing, Edge network, Edge computing architectures, OpenFog reference architecture for fog computing, Optimization in fog and edge computing

Case study: Open source platforms like Apache Edgen

UNIT-II	9 Hrs

Middleware: Middleware for Fog and Edge Computing: Introduction, Need for fog and edge computing middleware, Design goals, State-of-the-art middleware infrastructures, System model, Proposed architecture, Light weight container middleware for edge cloud architectures, Clusters for light weight edge clouds, Architecture management – Storage and orchestration, IoT integration, Security management for edge cloud architectures, Data Management in Fog Computing

UNIT-III	9 Hrs

Predictive Analysis: Predictive Analysis to Support Fog Application Deployment, Using Machine Learning for Protecting the Security and Privacy of Internet of Things (IoT) Systems, Survey of ML Techniques for Defending IoT Devices, Machine Learning in Fog Computing

UNIT-IV	9 Hrs

Applications: Applications of fog computing in Big Data Analytics, Health monitoring, Smart surveillance, Smart transportation, Modeling. Simulation of fog and edge computing Environments using open source platforms like iFogSim toolkit

Textbook(s):

1. Rajkumar Buyya, Satish Narayana Srirama, *Fog and Edge Computing: Principles and Paradigms*, 1st edition, Wiley, 2019

Reference Book(S):

1. Javid Taheri, Shuiguang Deng, *Edge Computing: Models, technologies and applications*,

IET, 2020
2. Xin Sun and Amin Vahdat, *Edge Computing: A Primer*, CRC Press, 2019
3. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani and M. Niranjanamurthy, *Edge Computing Fundamentals, Advances and Applications*, CRC Press, 2022

Web and Video link(s):

https://nptel.ac.in/courses/106104449; *NPTEL Video Lecture on Edge Computing by Prof. Rajiv Misra, Professor of CSE, IIT Kanpur*

Course Articulation Matrix (CAM):				U24AI802C: EDGE AND FOG COMPUTING										
CO		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	U24AI802C.1	2	1	-	-	1	-	-	-	-	-	1	1	1
CO2	U24AI802C.2	2	2	1	1	1	-	-	-	1	1	1	2	2
CO3	U24AI802C.3	2	2	2	1	2	-	-	1	1	-	2	2	2
CO4	U24AI802C.4	2	2	2	1	2	-	-	1	-	2	2	2	2
U24AI802C		2	1.75	1.6	1	1.5	-	-	1	1	1.5	1.5	1.75	1.75
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	CO Statement *The student should be able to…*	Relevant SDG	SDG Description	Mapping Justification
CO1	understand the foundations of fog and edge computing networks and different architectures	SDG9	Industry, Innovation and Infrastructure	fog and edge computing technologies strengthen modern digital infrastructure and support innovative computing solutions. Understanding these architectures helps in building reliable and scalable smart systems for industries and society
CO2	design fog and edge computing based systems and applications using reference architectures	SDG9	Industry, Innovation and Infrastructure	designing edge and fog-based applications promotes industrial innovation and development of intelligent infrastructure. These systems improve efficiency, connectivity, and real-time service delivery in smart environments.
CO3	understand and apply data collection, analysis, decision making and learning methodologies over the edge for different applications	SDG11	Sustainable Cities and Communities	edge-based data analysis and intelligent decision-making support advanced learning technologies and smart city applications. These methodologies enable efficient resource utilization, automation, and data-driven solutions for sustainable communities.

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO4	apply optimization techniques for edge and fog computing	SDG12	Responsible Consumption and Production	optimization techniques reduce energy consumption, latency, and resource wastage in distributed computing systems. Efficient utilization of computational resources contributes to sustainable and energy-aware technology solutions.

TEXT AND SPEECH ANALYTICS

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI802D**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**3-0-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : apply foundational NLP techniques to process and analyze textual data

CO2 : develop models for text classification, sentiment analysis, and topic modeling using appropriate NLP methods

CO3 : extract meaningful features from speech signals by applying relevant speech processing techniques

CO4 : build and evaluate models for speech recognition, speech synthesis and speaker identification using suitable algorithms

UNIT-I	9 Hrs

Introduction: What is Text Representation and Embeddings, Text Classification and Summarization using Deep Learning

Introduction to Natural Language Processing (NLP): Levels of NLP, Basic Text Processing, Language Modelling, Vector Space Model (VSM), One-Hot Encoding

Traditional vs deep learning models for text classification: Introduction to Attention Mechanisms, Transformers, Fine-tuning pretrained models for classification tasks, Extractive vs Abstractive summarization, Transformer-based models for text Summarization, Sequence Labeling for Parts of Speech and Named Entities

UNIT-II	9 Hrs

Machine Translation: Machine Translation using Encoder-Decoder

Information Retrieval: Information Retrieval with Dense Vectors, Information Retrieval with RAG

Information Extraction: Relations, Events, Time – Semantic Role Labeling

Dependency Parsing: Graph-Based Dependency Parsing

UNIT-III	9 Hrs

Phonetic representation: Short-Time Analysis of Speech, Spectrogram analysis, Feature Extraction

Dependency Parsing: Graph-Based Dependency Parsing

Automatic Speech Recognition (ASR): Acoustic Modeling, Traditional models, Transition to Deep Learning, Language Modeling End-to-End

ASR: Connectionist Temporal Classification (CTC), Attention-based and Transformer based models wav2vec. **Case Study:** Implement CTC for Speech Recognition in Noisy Environments

UNIT-IV	9 Hrs

Speech Synthesis: Text-to-Speech (TTS) pipeline overview, Formant synthesis vs Concatenative synthesis, Parametric synthesis, Neural TTS models, Variational Inference TTS, Voice conversion and style transfer, Sequence-to-sequence Modelling, Attention mechanisms in TTS

Case Study: Emotional states recognition using both spoken words(text) and vocal tone

(Speech)

Textbook(s):

1. Daniel Jurafsky, James H. Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*, 3rd edition, 2025
2. Denis Rothman, *Transformers for Natural Language Processing*, Packt Publishing, 2022
3. L R Rabiner and R W Schafer, *Theory and Application of Digital Speech Processing*, Pearson, 2011
4. Denis Rothman, *RAG-Driven Generative AI*, Packt Publishing, 2024

Reference Book(S):

1. Anil K. Jain, *Fundamentals of Image Processing*, Pearson, 1st edition, 2015, Chennai
2. B. Chanda, D. Dutta Majunder, *Digital Image Processing and Analysis*, Prentice Hall of India, 2nd edition, 2011, New Delhi

idhar, *Digital Image Processing*, Oxford University Press, 2nd edition, 2016, Noida

4. Munesh C. Trivedi, *Digital Image Processing*, Khanna Book Publishing, 1st edition, 2014, New Delhi

Web and Video link(s):

https://onlinecourses.nptel.ac.in/noc22_ee117/preview; *NPTEL Video Lecture on Digital Speech Processing by Prof. Shyamal Kumar Das Mandal, Professor of EEE, IIT Kharagpur*

Course Articulation Matrix (CAM):				**U24AIS802D :TEXT AND SPEECH ANALYTICS**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI802D.1**	2	2	1	1	2	-	-	-	-	-	-	2	2
CO2	**U24AI802D.2**	2	2	2	2	3	-	-	-	1	-	-	3	2
CO3	**U24AI802D.3**	2	2	2	2	3	-	-	-	1	-	-	3	2
CO4	**U24AI802D.4**	2	2	3	3	3	-	-	-	1	-	1	3	3
U24AI802D		2	2	2.0	2.0	2.75	-	-	-	1	-	1	2.75	2.25
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	apply foundational NLP techniques to process and analyze textual data.	SDG4	Quality Education	NLP enables smart tutoring systems, automated content generation, and multilingual learning tools
CO2	develop models for text classification, sentiment analysis, and topic modeling using appropriate NLP methods.	SDG9	Industry, Innovation and Infrastructure	NLP models power chatbots, search engines, and automation in industries
CO3	extract meaningful features from speech signals by applying relevant speech processing techniques.	SDG3	Good Health & Well-being	Speech analysis helps detect mental health issues, stress, and neurological disorders
CO4	build and evaluate models for speech recognition, speech synthesis and	SDG10	Reduced Inequalities	Speech tech (ASR, TTS) supports accessibility for visually impaired and regional language users

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	speaker identification using suitable algorithms.			

CONVERSATIONAL AI

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI802E**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1: understand the fundamental concepts of dialogue systems, including their history, types, and design principles

CO2: apply rule-based and statistical data-driven approaches, including reinforcement learning techniques, for building conversational systems

CO3: evaluate conversational systems using appropriate evaluation methods, frameworks, and performance metrics

CO4: analyze and implement end-to-end neural dialogue systems using modern approaches and techniques

UNIT-I	9 Hrs

Introduction of Dialogue Systems: History of dialogue systems, Present-day dialogue systems, Modelling conversation dialogue systems, Designing and developing dialogue systems

UNIT-II	9 Hrs

Dialogue Systems Architecture: Designing a dialogue system, Tools for developing dialogue systems, Rule-based techniques in dialogue systems, Participating in the alexa prize

Motivating the Statistical Data-Driven Approach: Dialogue components in the statistical data-driven approach, Reinforcement learning (RL), Representing dialogue as a markov decision process, From MDPs to POMDPs, Dialogue state tracking, Dialogue policy, Problems and issues with reinforcement learning in POMDPs

UNIT-III	9 Hrs

Evaluating Dialogue Systems: Process of evaluation, Evaluating task-oriented dialogue systems, Evaluating open-domain dialogue systems, Evaluation frameworks- PARADISE, Quality of Experience (QoE), Interaction quality, Best way to evaluate dialogue systems

UNIT-IV	9 Hrs

End-to-End Neural Dialogue Systems: Neural network approaches to dialogue modelling, A neural conversational model, Introduction to the Technology of neural dialogue, Retrieval-based response generation, Task-oriented neural dialogue systems, Open-domain neural dialogue systems, Some issues and current solutions

Dialogue Systems: Datasets, Competitions, Tasks, and Challenges

Textbook(s):

1. Michael McTear, *Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots*, Moran and Claypool Publishers, 2nd edition, 2020, San Rafael. *(Chapters 1 to 8)*
2. Andrew R. Freed, *Conversational AI*, Manning Publications, 1st edition, 2021, Shelter Island. *(Chapters 1 to 7, 9)*

Reference Book(s):

1. Cathy Pearl, *Designing Voice User Interfaces: Principles of Conversational Experiences*, O'Reilly Media, 1st edition, 2016, Sebastopol.
2. Daniel Jurafsky, James H. Martin, *Speech and Language Processing*, Pearson, 3rd edition, 2023, New York.
3. Hobson Lane, Cole Howard, Hannes Hapke, *Natural Language Processing in Action*, Manning Publications, 1st edition, 2019, Shelter Island.

Web and Video link(s):

https://nptel.ac.in/courses/106105158; *NPTEL Video Lecture on Natural Language Processing by **Prof. Pawan Goyal**, IIT Kharagpur.*

Course Articulation Matrix (CAM):		**U24AI802E: CONVERSATIONAL AI**												
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI802E.1**	2	2	-	-	1	-	-	-	-	-	-	1	3
CO2	**U24AI802E.2**	2	3	3	2	3	-	-	-	1	-	-	2	2
CO3	**U24AI802E.3**	2	3	2	3	2	-	-	-	-	-	-	2	2
CO4	**U24AI802E.4**	2	3	3	3	3	-	-	1	1	-	-	2	2
U24AI802E		2	2.75	2.66	2.66	2.25	-	-	1	1	-	-	1.75	2.25
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *(The student should be able to...)*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand dialogue systems, their history, types, and design principles	SDG 4	Quality Education	Focuses on learning and understanding core AI concepts
CO2	Apply rule-based and statistical data-driven approaches including RL	SDG 9	Industry, Innovation and Infrastructure	Supports development of innovative AI systems
CO3	Evaluate conversational systems using metrics and frameworks	SDG 8	Decent Work and Economic Growth	Improves efficiency, productivity and system performance
CO4	Analyze and implement end-to-end neural dialogue systems	SDG 9	Industry, Innovation and Infrastructure	Contributes to advanced intelligent system development

CYBER SECURITY AND DIGITAL FORENSICS

Class: B. Tech. VIII – Semester		**Branch:** CSE (AI & ML)	
Course Code:	**U24AI803**	**Credits:**	**3**
Hours/Week (L-T-P- E):	**2-1-0-3**	**CIE:**	**60%**
Total Number of Teaching Hours:	**36 Hrs**	**ESE:**	**40%**

Course Learning Outcomes (COs)

After completion of this course, the students should be able to,

CO1 : understand the fundamentals of cyber crime and information security and explain the relationship between digital technologies and cyber threats

CO2 : identify cybercrimes associated with mobile and wireless environments, including mobile banking frauds, phishing, SIM cloning, and credit card frauds

CO3 : understand the concepts of cyber crime, cyber security, and cyber law and explain their significance in the digital world

CO4 : identify and classify different types of digital forensics, such as computer forensics, network forensics, mobile forensics, cloud forensics, and database forensics

UNIT-I	9 Hrs

Introduction to Cyber-crime: Introduction, Cyber-crime and information security, who are cyber criminals, Classifications of cyber-crimes, Cyber-crime - The legal perspectives and Indian perspective, Cyber-crime and the Indian ita 2000, A global perspective on cyber- crimes, Cyber offenses: How criminals plan them: Introduction, How criminals plan the attacks, Social engineering, Cybers talking, Cyber cafe and cyber-crimes, Botnets: The fuel for cybercrime, Attack vector, Cloud computing

Case Study: A comprehensive digital forensic case study on mirai botnet servers

UNIT-II	9 Hrs

Cyber-crime: Mobile and wireless devices: Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Creditcard fraaudsin mobile and wireless computing era, Security challenges posed by mobile devices, Registry settings for mobile devices, authentication service security, Attacks on mobile/cellphones, Mobile devices: Security implications for organizations, Organizational measures for handling mobile, organizational security policies and measures in mobile computing era, Laptops

Case Study: A Case Study on the mobile malware: cabassous/flubot

UNIT-III	9 Hrs

Cyber-crimes and cyber security: The legal perspectives - Introduction, Cyber-crime and legal landscape around the world, Need of cyber laws: The indian context, The indian it acts, Challenges to indian law and cyber-crime scenario in india, Digital signatures and the indian it acts, Amendments to the indian it acts, Cyber-crime and punishment, Cyber law, Technology and students: Indian scenario

Case study: conviction of PARK JIN HYOK held in brambul worm attack

UNIT-IV	9 Hrs

Introduction to digital forensics and digital evidences: Introduction to digital forensic,

Need of digital forensic, Digital evidence/digital forensic, Types of digital forensics, Ethical issues, digital forensic investigations, Introduction to digital evidences, Rules of digital evidence, Characteristics of digital evidence, Types of evidence, Challenges in evidence handling. **Case study:** Post-retrieval search hit clustering to improve information retrieval Effectiveness
Textbook(s): 1. Nina Godbole, Sunil Belapure, *Cyber Security: Understanding Cyber Crimes, Compute Forensics and Legal Perspectives*, Wiley India Pvt. Ltd., 1st edition, 2011, New Delhi *(chapter 1, 2, 3, 4, 5, 6, 7)* 2. Dr. Nilakshi Jain and Dr. Dhananjay R. Kalbande, *Digital Forensic*, Wiley India Pvt. Ltd., 2018, New Delhi *(chapter 2, 3, 4)*
Reference Book(s): 1. James Graham, Richard Howard and Ryan Otson, *Cyber Security Essentials*, CRC Press T&F Group, 1st edition, 2011, New York 2. Chwan-Hwa(john) Wu, J. David Irwin, *Introduction to Cyber Security*, CRCP Edition,2013, New York 3. Thomas A Johnson, *Cyber Security: Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare*, CRC Press T & F Group, 1st edition, 2020, New Delhi
Web and Video link(s): https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ma01 https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs144

Course Articulation Matrix (CAM):				**U24AI803: CYBER SECURITY AND DIGITALFORENSICS**									
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI803.1**	1	2	1	2	1	-	-	1	1	1	-	1	2
CO2	**U24AI803.2**	2	3	2	2	2	-	-	1	1	1	-	2	2
CO3	**U24AI803.3**	2	2	2	2	1	-	-	1	1	1	-	1	2
CO4	**U24AI803.4**	2	2	1	3	2	-	-	1	1	1	-	2	2
U24AI803		1.75	2.25	1.5	2.25	1.5	-	-	1	1	1	-	1.5	2
3 – HIGH, 2 – MEDIUM, 1 – LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	Understand the fundamentals of cyber crime and information security and explain the relationship between digital technologies and cyber threats	SDG9	Industry, Innovation and Infrastructure	Network security and cybersecurity help in building secure digital infrastructure, protecting communication systems, data, online services, and technological innovation from cyber threats
CO2	Identify cybercrimes associated with mobile and wireless environments,	SDG16	Peace, Justice and Strong Institutions	Aims to reduce crime, including cybercrime. Supports strengthening laws,

CO–SDG Alignment Matrix				
CO	**CO Statement** *The student should be able to…*	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	including mobile banking frauds, phishing, SIM cloning, and credit card frauds			cybersecurity policies, and institutions to combat fraud, identity theft, phishing, and financial cybercrimes
CO3	understand the concepts of cyber crime, cyber security, and cyber law and explain their significance in the digital world	SDG9	Industry, Innovation and Infrastructure	Develop secure, reliable, and resilient digital communication infrastructure through cybersecurity and network protection mechanisms
CO4	identify and classify different types of digital forensics, such as computer forensics, network forensics, mobile forensics, cloud forensics, and database forensics.	SDG16	Peace, Justice and Strong Institutions	Supports the investigation and prevention of cybercrime through digital evidence. Strengthens law enforcement and judicial systems by enabling effective digital forensic investigations. Promotes secure, accountable, and trustworthy digital ecosystems

MAJOR PROJECT PHASE - 2

Class: B. Tech. VIII – Semester		**Branch: CSE (AI & ML)**	
Course Code:	**U24AI804**	**Credits:**	**6**
Hours/Week (L-T-P- E):	**0-0-12-12**	**CIE:**	**60%**
Total Number of Teaching Hours:	**-**	**ESE:**	**40%**

Course Learning Outcomes (COs):
After completion of this course, the students should be able to,

Upon completion of the major project work, students will be able to…

CO1: review research literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (Technical skills)

CO2: design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)

CO3: apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (Ethics and teamwork)

CO4: collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (Communication skills and life-long learning)

1. Major project work shall be continued in 8^{th} semester as major project *phase-II*: All the major project teams shall take the *phase -I* work forward and complete the remaining work as *Phase-II* in the 8^{th} semester.
2. Final Year Major Project work represents the culmination of study towards the B. Tech degree. Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems. The student learning assessment process (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project
3. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
4. Team work: Major project work is a team work
   (i) The students of a project team shall work together to achieve a common objective.
   (ii) Every student of a project team is expected to function effectively as an

individual, and also with others as a team member in an ecosystem of team having knowledge diversity, gender diversity, social and cultural diversity among its members.

5. Every student is expected to put approximately **168 hours of work** into the major projectphase-IIcourse over the 12 weeks of 8thsemester.
6. **Major project work *Phase-II*: 8th semester**
   - (i) The convener DPEC shall release complete schedule of *phase-II* CIE during last week of 7thsemester (*well in advance before start of 8thsemester*), immediately after completion of Progress Presentation-I, so that student teams would complete the scheduled works during inter-semester break and get ready with informative, confident and comfortable presentation for progress presentation-II.
   - (ii) The project supervisors: The project supervisors are expected to guide the students to systematically continue the phase-I work, useful work during inter- semester break, meeting the deadlines as proposed in project timeline.
   - (iii) The project supervisors shall ensure students focus on the project objectives and expected deliverables
   - (iv) The project supervisors shall ensure students have sufficient resources for successful project completion.
   - (v) The project supervisors shall ensure students have sufficient resources for successful project completion.
   - (vi) The project supervisors shall continue guiding students on
     - (a) *Engineering Knowledge - Applies engineering fundamentals, computing knowledge, and domain-specific concepts to solve the selected project problem*
     - (b) *Problem Analysis - Identifies, formulates, and analyzes a real-world engineering problem through literature review and requirement analysis*
     - (c) *Design/Development of Solutions - Designs and develops an innovative solution, system, or application that satisfies functional requirements while considering societal and environmental aspects*
     - (d) *Conduct Investigations of Complex Problems - Conducts experiments, collects and analyzes data, validates results, and draws meaningful conclusions using research methodologies*
     - (e) *Engineering Tool Usage - Uses modern engineering and IT tools, software frameworks, simulation tools, IDEs, databases, AI tools, and testing platforms for implementation*
     - (f) *The Engineer and the World - Evaluates the project's impact on society, sustainability, economy, health, safety, legal, cultural, and environmental aspects wherever applicable*
     - (g) *Ethics - Follows professional ethics by ensuring originality, respecting intellectual property, maintaining data privacy, and adhering to ethical standards*
     - (h) *Individual and Collaborative Team Work - Works effectively as an individual and as a member of a multidisciplinary project team, demonstrating leadership and collaboration*
     - (i) *Communication - Prepares project reports, technical documentation, presentations, demonstrations, and communicates project outcomes effectively*
     - (j) *Project Management and Finance - Plans project activities, schedules tasks, manages resources, estimates costs (where applicable), and completes milestones within timelines*
     - (k) *Life-Long Learning - Learns emerging technologies, research methodologies, and new tools independently to successfully complete the projects*

(l) *Project management and finance* – to demonstrate knowledge and understandingof the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

(m) *Life-long learning* – to recognize the need for, and have the preparation andability to engage in independent and life-long learning in the broadest context of technological change

(vii) The project supervisors are also expected to continuously emphasize and guide the students on

(a) **Following project timeline**: completing the tasks as planned in projecttimeline

(b) **Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadence and considered for evaluation during presentations,i.e., number of planned meetings and number attended by students

(c) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-II*, the supervisor shallspecifically comment, in the project log book, on whether the project team met each of the project work outcomes and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(d) Writing down whatever is done and making notes of whatever is read.

Writing down the procedures / models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, *difficulties faced and how they were fixed* are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well-documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on. This information will be needed for the bibliography in your project report. On the other hand, documenting a report *on the spur of the moment* would end upcopying things from other sources resulting in a plagiarized document.

(e) The relevant knowledge, skills and qualities (KSQ) an engineering graduate should possess, whichcan bespecially acquiredby participating in major project work

(f) Good and sufficient literature review: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing the proposed work by the end of *phase-II*

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented overall project report in proper format, covering the complete work carried out during both the phases (*phase-I and phase-II*).

(j) Consequences of plagiarism, and use of anti-plagiarism software to detect plagiarism in the report

(k) Submission of major project work report within acceptable plagiarism levels (including AI Plagiarism), as per the *Anti-plagiarism policy-2020 of our institute*

(l) **Video pitch on complete project work**: Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the complete work done during both phases (*phase-I and phase-II*).

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to present their project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) **Phase – II evaluation**: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Progress Presentation -II** *(during third / fourth week of 8thsemester):* The progress presentation-II shall include the identified problem, objective(s), literature review, expected outcome(s), results of work done as per project plan timeline.

i. **Following project timeline**: The project timeline shall be meticulouslyfollowed and the tasks shall be completed as planned in project timeline.
ii. 80-85% of work is expected to be completed
iii. Project teams shall compulsorily show the following as part of their progress presentation-II
    1. *The slides on project timeline and*
    2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*

iv. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (with due signatures of project supervisor) during presentations

(b) **Final Presentation** *(during penultimate week of 8th semester):* **Project supervisor shall ensure that the project team has accomplished 100% of work proposed**. The project team shall

i. **Follow project timeline**: The project timeline shall be meticulouslyfollowed and the tasks shall be completed as planned in project timeline.
ii. compulsorily show the following as part of their final presentation
    1. *The slides on project timeline and*
    2. *A table showing targeted tasks as per timeline and whether all the identified tasks accomplished?*
iii. **show project log book**: Every student of the Project team shall compulsorily show the complete activity journaling in the log book (*with due signatures of project supervisor*)
iv. present complete results & analysis
v. **demonstrate the completed project**: working model / process / software package / system developed
vi. demonstrate the completed project with the **project poster presentation**

(ix) **Evaluation for Major project phase-II:**There shall be continuous internal evaluation (CIE) and end semester examination (ESE). The evaluation for *phase-II* shall be as given below:

S.No	Assessment Component	Weightage (%)	CO Mapping	PO Mapping
A.	CIE	60%		
1	Supervisor Assessment (Individual Contribution & Teamwork)	10	CO1, CO2	PO9, PO10
2	Implementation & Working Model	10	CO2, CO3	PO3, PO5
3	Project Video Pitch	5	CO3, CO4	PO9, PO10
4	Project Poster	5	CO3, CO4	PO9, PO10
5	Research Alignment	10	CO2, CO3	PO2, PO3
6	Oral Presentation /Viva Voce	20	CO3, CO4	PO9, PO10

B.	ESE	40%		
1	Major Project Thesis Report	10	CO1, CO4	PO1, PO8
2	Final Oral Presentation/ Viva Voce	30	CO3, CO4	PO9, PO10
Total		100		

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system on the chosen work. The completed working model/ process/software package/system shall be demonstrated during the final presentation at the end of *phase-II*.

(b) **Video pitch**: Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I & phase-II*. The project team shall present the produced video pitch during Final presentation. The produced video pitch should

7. be 3 to 5-minute-long video (no longer than 5 minutes)
8. be concise and to the point, on the problem, proposed solution and its salient features.
9. show project timeline and sample page of log book
10. highlight the various stages during project implementation with the help of short videos / photos / screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project.
11. discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*
12. emphasize key points about *business idea, potential market for the proposed solution*

(a) **Project poster**: At the end, the project teams shall present their project in the form of posters (A2 size). The teams shall have to present their work during the poster presentation session scheduled at the end of the 8^{th}semester, at the time of demonstration of complete porotype / working model / software package / system developed.

(b) **Well-documented plagiarism-cleared project report**: Every project team shall be required to submit a well-documented project report on the work carried out, as per the format specified by the DPEC. The report should clear plagiarism check as per the anti-plagiarism policy-2020 of the institute. The following shall compulsorily be included in the Results-Chapter of the project report

13. Photos / screen shots taken at various stages during the development of working model/ process/software package/system as part of Results-Chapter
14. Snapshot of final working model/ process/software package/system developed
15. Pictures of the team working in the lab, the team discussing with the project supervisor, working on creative project, or an event they are attending for work.
16. All *these photos / screen shots shall be properly referred in the project report by assigning figure numbers*

(a) **Tangible outcomes of project work in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own wordswhat they learnt from the project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of major project work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be shown in the conclusions chapter.

(b) **Student feedback on major project in Conclusions - Chapter:** To gatherinformation on whether project work was useful and gave practical experience on chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*) with closed and open questions shall be kept in the conclusions chapter of the project report.

(ii) It is mandatory for

(a) every student of the team to appear for ESE oral presentation and viva-voce, to qualify for course evaluation

(b) every project team to write a technical paper based on the solution(s) proposed, results obtained and prototype/working model/process/software package/system developed, for submission to a reputed non-predatoryconference/non-paid peer-reviewed journal

(c) every project team shall be required to create a pitch video, which is a video presentation on their major project work phase-I & phase-II

(d) every project team shall present their project in the form of a poster, during the demonstration of complete prototype/working model/software package/system developed

(iii) The student has to register for the Major project work phase-IIas supplementary examination in the following cases:

(iv) he/she is absent for oral presentation and viva-voce as part of ESE presentation

(v) he/she fails to fulfill the requirements of Major project work phase-IIevaluation as per specified guidelines

(vi) Supplementary examination for Major project work phase-II

17. The CoE shall send the list of students registered for supplementary examination to the HoDs concerned
18. The DPEC, duly constituted by the HoD, shall conduct Major Project Phase-IIsupplementary exam and send the award list to the CoE within the stipulated time

<u>Major Project Phase-2 Evaluation Rubrics</u>

S. No.	Assessment Component	Evaluation Criteria	Max Marks
A. CIE Evaluation – 60 %			
1	Supervisor Assessment	Individual Contribution & Regularity (5M)	10
		Teamwork & Collaboration (5M)	
2	Implementation & Working Model	Implementation & Functionality (5M)	10
		Innovation (5M)	
3	Project Video Pitch	Visual Quality, Content Clarity & Delivery (5M)	5
4	Project Video Poster	Content, Design & Clarity (5M)	5
5	Research Alignment	Publication Quality & Indexing (5M)	10

		Research Contribution & Novelty (5M)	
6	Oral Presentation & Viva Voce	PPT & Delivery (5M)	20
		Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
B. ESE Evaluation – 40 %			
1	Major Project Thesis Report	Structure, Clarity & Writing (5M)	10
		Technical Content & Analysis (5M)	
2	Final Oral Presentation/ Viva Voce	PPT & Delivery (5M)	30
		Conceptual Understanding (5M)	
		Implementation Knowledge (5M)	
		Communication Skills (5M)	
		Critical Thinking (5M)	
		Confidence and Body language (5M)	

Course Articulation Matrix (CAM):				**U24AI804: MAJOR PROJECT PHASE - 2**										
CO		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**U24AI804.1**	3	3	2	3	2	1	1	**1**	**1**	**1**	**2**	2	2
CO2	**U24AI804.2**	3	2	3	2	2	1	2	**1**	**1**	**2**	**2**	2	1
CO3	**U24AI804.3**	1	1	1	1	1	2	1	**1**	**2**	**2**	**1**	2	1
CO4	**U24AI804.4**	1	1	1	2	2	1	2	**1**	**2**	**1**	**2**	2	2
U24AI804		2	1.75	1.75	2	1.75	1.25	1.5	**1**	**1.5**	**1.5**	**1.75**	**2**	**1.5**
3 – HIGH, 2 – MEDIUM, 1 - LOW														

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
CO1	review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex	**SDG 13**	Industry, Innovation and Infrastructure	Research-based innovation and development of advanced ECE solutions contribute to technological progress, industrial growth, and infrastructure development.

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	engineering problems (Technical skills)			
CO2	design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (Problem solving and critical thinking skills)	**SDG 12**	Responsible Consumption and Production	Sustainable design practices, efficient resource utilization, and environmentally responsible engineering solutions promote responsible production and innovation.
CO3	Apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader of a multidisciplinary team.	**SDG 11**	Sustainable Cities and Communities	Collaborative development of engineering solutions addressing societal needs contributes to sustainable and resilient communities.
CO4	Collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a	**SDG 4**	Quality Education	Technical communication, knowledge dissemination, and self-directed learning support continuous education and professional growth.

CO–SDG Alignment Matrix				
CO	**CO Statement (The student should be able to…)**	**Relevant SDG**	**SDG Description**	**Mapping Justification**
	professional engineer (Communication skills and life-long learning)			