SCHEME OF INSTRUCTION AND SYLLABI OF

B.E. / B.TECH. I to VIII Semesters FOR

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2022-23)

(R–22 A Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++) Kokapet Village, Gandipet Mandal, Hyderabad– 500 075. Telangana

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OFARTIFICIAL INTELLIGENCE AND DATA SCIENCE

INSTITUTE VISION AND MISSION:

Vision: To be a Centre of Excellence in Technical Education and Research

Mission: To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION:

VISION

To be a center of excellence in the field of Information Technology that yields pioneers and research experts who can contribute for the socio-economic development of the nation.

MISSION

- To impart state-of-the-art value-based education in the field of Information Technology.
- To collaborate with industries and research organizations and excel in the emerging areas of research.
- To imbibe social responsibility in students.
- To motivate students to be trend setters and technopreneurs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

Graduates of AI & DS will be able to:

1. AdaptemergingtechnologiesofArtificialIntelligence&DataScienceanddevelopstateoftheartsolutionsinthefi elds of Manufacturing, Agriculture, Health-care, Education, and Cyber Security.
2. Exhibit professional leadership qualities to excel in inter disciplinary domains.
3. Possess human values, professional ethics, application-oriented skills, and engage in lifelong learning.
4. Contribute to the research community to meet the needs of public and private sectors.

PROGRAM SPECIFIC OUTCOMES (PSOS):

After successful completion of the program, students will be able to:

1. Exhibit proficiency of Artificial Intelligence and Data Science in providing sustainable solutions by adapting to societal, environmental and ethical concerns to real world problems.
2. Develop professional skills in the thrust areas like ANN and Deep learning, Robotics, Internet of Things and Big Data Analytics.

Pursue higher studies in Artificial Intelligence and Data Science in reputed Universities and to work in research establishments.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC01	Linear Algebra & Calculus	3	1	-	3	40	60	4
2	22PYC01	Optics and Semiconductor Physics	3	-	-	3	40	60	3
3	22CSC01N	Problem Solving and Programming using C	2	1	-	3	40	60	3
4	22EGC01	English	2	-	-	3	40	60	2
PRACTICAL									
5	22PYC03	Optics and Semiconductor Physics Lab	-	-	3	3	50	50	1.5
6	22EGC02	English lab	-	-	2	3	50	50	1
7	22CSC02N	Problem Solving and Programming using C Lab	-	-	3	3	50	50	1.5
8	22MEC01N	Engineering Graphics	-	1	3	3	50	50	2.5
9	22MEC38N	Digital Fabrication Workshop	-	-	3	3	50	50	1.5
TOTAL			**10**	**3**	**14**		**410**	**490**	**20**
Clock Hours Per Week: 27									

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical** **SEE: Semester End Examination**

22MTC01

LINEAR ALGEBRA & CALCULUS
(AI&DS)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:
1. To explain the Partial Derivatives and the extreme values of functions of two variables.
2. To discuss Physical interpretations of scalar and vector functions.
3. To discuss line, surface and volume integrals.
4. To explain the concepts of basis, dimension of vector space and matrix representation of a linear transformation.
5. To explain the solution of the system of linear equations by Matrix Methods.

Course Outcomes: Upon completing this course, students will be able to:
1. Determine the extreme values of functions of two variables.
2. Apply the vector differential operator to scalar and vector functions
3. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
4. Determine the basis and dimension of a vector space, compute linear transformation.
5. Apply the Matrix Methods to solve the system of linear equations.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	2	1	1	-
CO2	3	3	3	3	-	-	-	-	-	-	2	1	1	-
CO3	3	3	3	3	-	-	-	-	-	-	-	2	1	-
CO4	3	3	3	3	-	-	-	-	-	-	1	2	2	-
CO5	3	3	3	3	-	-	-	-	-	-	1	2	2	-

UNIT-I

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobeans, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT-II

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrigational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT-III

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-IV:

Vector space: Vector space, Subspace, linear combination of vectors, linear span, row and column spaces, linear dependent, independent vectors, basis, dimension, linear transformation, invertible transformation, matrix of linear transformation, kernel and range of LT, rank and nullity of LT-rank nullity theorem (without proof), change of basis.

UNIT-V

Matrices: Rank of a matrix, Echelon form, consistency of linear System of equations, Eigen values, Eigenvectors, Properties of Eigen values, Cayley-Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

Textbooks:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. Seymour Lipschutz, "Schaum's Outline of Linear Algebra", 5th Edition, McGraw Hill, 2013.
4. Gilbert Strang, "Introduction to linear algebra", 5th Edition, Wellesley - Cambridge press, 2016.

Suggested Reading:

1. Veera Rajan T., "Engineering Mathematics for first year", Tata McGraw- Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, 5th edition, 2016.
3. D. Poole, "Linear Algebra: A Modern Introduction, 2nd Edition", Brooks/ Cole, 2005.
4. Kuldeep Singh, "Linear algebra: step by step". OUP Oxford, 2013.

Online:

Course Code	Course Name	Resource Links
22MTC01	Linear Algebra and Calculus	1. https://nptel.ac.in/courses/111104125 2. https://archive.nptel.ac.in/courses/111/107/111107112/ (Unit- 1,3,5 and 6) 3. https://nptel.ac.in/courses/111108098 (Unit-1,3 and 9) 4. https://nptel.ac.in/courses/111102152 (Week -1 to Week- 6)

22PYC01

OPTICS AND SEMICONDUCTOR PHYSICS

(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology AI&ML, AI&DS)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

Course Objectives:

1. Understand the fundamentals of wave nature of flight
2. Acquire knowledge of lasers, holography and Fiber optics
3. Familiarize with quantum mechanics
4. Learn the fundamental concepts of solids

Course Outcomes:

1. Analyse the wave nature of light by correlating theoretical concepts with experimental results.
2. Categorize lasers and optical fibres for real time applications.
3. Interpret the principles of wave mechanics and its quantum effects.
4. Outline the evolution of different models to classify the solids electrically.
5. Examine the characteristics of semiconductors and their devices.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	2	1	1	-	-	2	-	-	-
CO2	3	3	3	3	3	3	3	2	-	3	2	-	-	-
CO3	3	3	3	3	3	2	2	1	-	-	2	-	-	-
CO4	2	2	2	1	2	2	2	1	-	2	2	-	-	-
CO5	3	2	2	2	2	2	3	2	-	3	2	-	-	-

UNIT-I

Wave Optics: Huygens' principle –Superposition of waves –Interference of light by wave front splitting and amplitude splitting–Fresnel's biprism – Interference in thin films in reflected light– Newton's rings– Fraunhoffer diffraction from a single slit –Double slit diffraction – Rayleigh criterion for limit of resolution– Concept of N-slits–Diffraction grating and its resolving power.

UNIT-II

Lasers & Holography: Characteristics of lasers – Einstein's coefficients –Amplification of light by population inversion –Different types of lasers: solid-state lasers: Ruby & Nd: YAG; gas lasers: He-Ne & CO_2; semiconductor laser –Applications of lasers in engineering and medicine. Holography: Principle – Recording and reconstruction–Applications.

Fiber Optics: Introduction –Construction –Principle –Propagation of light through an optical fiber – Numerical aperture and acceptance angle –Step-index and graded-index fibers –Pulse dispersion –Fiber losses--Fiber optic communication system –Applications.

UNIT-III

Principles of Quantum Mechanics: Introduction –Wave nature of particles – de-Broglie hypothesis –

Physical significance of ψ –Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current –Wave packets –Uncertainty principle –Particle in infinite square well potential –Scattering from potential step – Potential barrier and tunneling.

UNIT-IV

Band Theory of Solids: Salient features of free electron theory of metals (Classical and Quantum) – Fermi level –Density of states – Bloch's theorem for particles in a periodic potential – Kronig-Penney model – Classification of solids: metals, semiconductors and insulators.

UNIT-V

Semiconductors: Intrinsic and extrinsic semiconductors –Charge carrier concentration in intrinsic semiconductors –Dependence of Fermi level on carrier concentration and temperature in extrinsic semiconductors (qualitative) –Carrier generation and recombination –Carrier transport: diffusion and drift – P-N junction – Thermistor – Hall effect – LED –Solar cell.

TEXTBOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications,2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Textbook of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications,2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications,2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications,2014.
2. V. Rajendran, *Engineering Physics*, McGraw-Hill Education Publications,2013.
3. P.K. Palanisamy, *Engineering Physics*, SciTech Publications,2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition,2015.

22CSC01N

PROBLEM SOLVING AND PROGRAMMING USING C

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites: Basic Mathematics.

Course Objectives:

1. Understanding the steps in problem solving and formulation of algorithms to problems.
2. Develop programming skills as a means of implementing an algorithmic solution with appropriate control and data structures.
3. Develop intuition to enable students to come up with creative approaches to problems.

Course Outcomes:

1. Formulate solutions to problems and represent those using algorithms/ Flowcharts.
2. Choose proper control statements and data structures to implement the algorithms
3. Decompose a problem into modules and use functions to implement the modules.
4. Develop programs using arrays, pointers and structures.
5. Develop applications using file I/O.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	3	3	1	2	-	-	-	-	1	-	-	3	3	1
CO 2	3	2	1	2	-	-	-	-	1	-	-	3	2	2
CO 3	3	2	1	2	-	-	-	-	1	-	-	3	3	1
CO 4	3	2	-	2	-	-	-	-	1	-	-	3	1	2
CO 5	2	1	-	-	-	-	-	-	-	-	-	3	1	2

UNIT - I

Introduction: Introduction to Programming, Idea of Algorithm, Representation of Algorithm, Flowchart, from algorithms to programs, source code.

Basics of C: Background, Structure of a C Program, Data types, Tokens, Operators and Expressions- Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions, Input and Output Functions.

UNIT - II

Control Statements: Conditional Execution -Selection Statements, Conditional Operator, Switch statement**.** Iteration Execution - While Construct, For Construct, do-while Construct Goto Statement, Special Control Statements, Nested Loops.

Arrays: One-Dimensional Arrays-Declaration, Initialization, internal representation. Multidimensional Arrays

UNIT – III

Strings: Strings: One-dimensional Character Arrays, Arrays of Strings: Two-dimensional Character Array

Functions: Concept, Uses, Prototype, Declaration, Parameter passing techniques, Passing Arrays to Functions, Storage Classes, Recursion.

UNIT - IV

Search and Sorting: searching algorithms-linear, binary sorting algorithms-bubble sort, selection sort.
Pointers: Declaring a Pointer, Initializing Pointers, Indirection Operator and Dereferencing, Arrays and Pointers, Pointers and Strings, Pointers to Pointers, Array of Pointers, Pointers to an Array, Two- dimensional Arrays and Pointers, Pointers to Functions and Dynamic Memory Allocation.

UNIT – V
User defined Data types: Structures- Declaring Structures and Structure Variables, Accessing the Members of a Structure, Initialization of Structures, Typedef, Nesting of Structures, Arrays and Structures, Structures and Pointers, Structures and Functions, Union, Enumeration Types.
Files: Using Files in C, Declaration of File Pointer, Working with Text Files, Character Input and Output, Working with Binary Files, Sequential Versus Random File Access, File Record.

Textbooks:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e", 2nd Edition Oxford University Press, 2012.

Suggested Reading:

1. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language" Prentice Hall India, 2nd Edition. 1990.
2. B.A. Forouzan and R.F. Gilberg A Structured Programming Approach in C, Cengage Learning, 2007.
3. Byron Gottfried, Schaum's" Outline of Programming with C", McGraw- Hill.
4. E. Balaguru swamy, Programming in ANSI C, Tata McGraw-Hill.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview.
2. https://archive.nptel.ac.in/courses/106/105/106105171/.

22EGC01N

ENGLISH

(B.E/B.Tech - Common to all Branches)

Instruction	2L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic knowledge of English grammar and vocabulary.

Course Objectives: The course is taught with the objectives of enabling the students to:

1. Improve their understanding of communication skills while developing their usage of English for correct use of grammar and vocabulary.
2. Equip themselves with Reading Comprehension strategies and techniques.
3. Enhance their writing skills through paragraphs, précis and essays by using devices of cohesion and coherence.
4. Build appropriate, longer meaningful sentences for professional writing through formal letters and e-mails.
5. Demonstrate knowledge of drafting formal reports to define, describe and classify the processes by following a proper structure.

Course Outcomes:

After successful completion of the course the students will be able to:

1. Step-up the awareness of correct usage of English grammar and vocabulary by speaking fluently and comprehensively with a grip on communication skills.
2. Apply effective reading techniques through critical reading exercises to enhance quality of life and to support lifelong learning.
3. Develop their ability to write paragraphs independently on any context with cohesion, edit essays coherently while realizing brevity through précis writing.
4. Construct sentences clearly and comprehensively to write effective business letters and draft emails for better professional communication.
5. Advance efficiency in writing, distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	2	3	3	2	3	1	2	2
CO2	1	1	1	1	1	2	1	1	2	1	3	1	1	2
CO3	1	2	1	1	-	2	1	1	3	1	3	1	1	2
CO4	1	2	1	1	-	2	2	2	2	2	3	2	2	3
CO5	1	2	1	2	1	3	2	3	3	2	3	1	1	2

UNIT-I Communication Skills:

Introduction, nature and importance of communication; Process of communication; Types of communication: verbal and non-verbal; Barriers to communication; Intrapersonal, Interpersonal communication; Understanding Johari Window.

Vocabulary & Grammar: The concept of Word Formation - Root words, Use of prefixes and suffixes to form derivatives, Standard abbreviations. Basic sentences.
Reading Task I.

UNIT-II Reading Skills:
The Reading process, purpose, different kinds of texts; Reading Comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Practice in Critical Reading passages
Vocabulary and Grammar: Determiners. Use of Synonyms and Antonyms, Construction of Sentences.
Reading Task II.

UNIT-III Writing Skills:
Paragraph Writing. – Structure and features of a paragraph; Essay writing, Cohesion and coherence. Techniques of writing précis.
Vocabulary & Grammar: Use of connectors and linkers, Tenses, Punctuation.
Reading Task III.

UNIT-IV Professional Writing Skills-1:
Letter Writing – Structure, format of a formal letter; Letter of Request and Response, Drafting Emails, Email and Mobile etiquette.
Vocabulary and Grammar: Phrasal verbs, Misplaced modifiers, Subject-verb agreement.
Reading Task IV

UNIT-V Professional Writing Skills-2:
Report writing – Importance, structure, elements & style of formal reports; Writing a formal report. Writing for Blogs.
Vocabulary and Grammar: Words often Confused, Common Errors. Avoiding Ambiguity & Redundancy.
Reading Task V.

Textbooks:

1. Sanjay Kumar & Pushp Lata, "English Language and Communication Skills for Engineers", Oxford University Press, 2018.
2. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.

Suggested Readings:

1. Ashraf, M Rizvi, "Effective Technical Communication", Tata McGraw-Hill, 2006.
2. Michael Swan, "Practical English Usage", Oxford University Press, 4th Edition, 2016.
3. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice" 3rd Edition, Oxford University Press, 2015.

22PYC03

OPTICS AND SEMICONDUCTOR PHYSICS LAB

(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology), AI&ML, AI&DS)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

Course Objectives: The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments.
2. Understand the behaviour of the light experimentally.
3. Analyze the conduction behaviour of semiconductor materials and opto-electronic devices.

Course Outcomes: At the end of the course, the student will be able to

1. Interpret the errors in the results of an experiment.
2. Demonstrate physical properties of light experimentally.
3. Make use of the principles of lasers and optical fibres for transmission of light.
4. Analyse the V-I characteristics of some optoelectronic and semiconductor devices.
5. Assess material properties through temperature characteristics in a given semiconductor device.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	3	3	3	-	1	2	-	-	-
CO2	3	3	2	2	2	2	3	3	-	1	3	-	-	-
CO3	3	3	3	3	3	1	3	3	-	1	2	-	-	-
CO4	3	3	3	2	2	1	3	3	-	1	3	-	-	-
CO5	3	2	2	3	2	1	3	3	-	1	2	-	-	-

Experiments

1.	Error Analysis	**:**	Estimation of errors in the determination of time period of a torsional Pendulum.
2.	Fresnel's Biprism	**:**	Determination of wavelength of given monochromatic source.
3.	Newton's Rings	**:**	Determination of wavelength of given monochromatic source.
4.	Single Slit Diffraction	**:**	Determination of wavelength of given monochromatic source.
5.	Diffraction Grating	**:**	Determination of wavelengths of two yellow lines of light of mercury lamp.
6.	Laser	**:**	Determination of wavelength of given semiconductor laser.
7.	Holography	:	Recording and reconstruction of a hologram.
8.	Optical Fiber	**:**	Determination of numerical aperture and power losses of given optical fiber
9.	Energy Gap	**:**	Determination of energy gap of given semiconductor.
10.	P-N Junction Diode	**:**	Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias.
11.	Thermistor	**:**	Determination of temperature coefficient of resistance of given thermistor

12.	Hall Effect	**:**	Determination of Hall coefficient, carrier concentration and mobility of charge carriers of given semiconductor specimen
13.	LED	**:**	Study of I-V characteristics of given LED.
14.	Solar Cell	**:**	Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance.
15.	Planck's Constant	**:**	Determination of Planck's constant using photocell.

NOTE: A minimum of TWELVE experiments should be done.

22EGC02N

ENGLISH LAB

(B.E/B.Tech - Common to all Branches)

Instruction	2P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic Knowledge of English Communication.

Course Objectives: This course will introduce the students

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation through computer-aided multi-media instruction.
2. To the significance and application of word and sentence stress and intonation.
3. To sufficient practice in listening to English spoken by educated English speakers in different socio-cultural and professional settings.
4. To reading and speaking activities enabling them to critically interpret and respond to different texts and contexts and produce speech with clarity and confidence.
5. To teamwork, role behavior while developing their ability to use language appropriately, to discuss in groups and make presentations.

Course Outcomes: After successful completion of the course the students will be able to

1. Define the speech sounds in English and understand the nuances of pronunciation in English.
2. Produce speech with clarity and confidence using correct words and sentence stress, and intonation.
3. Achieve improved ability to listen, understand, analyze, and respond to English spoken in various settings.
4. Read, interpret, and review a variety of written texts, contexts, and perform appropriately in different situations.
5. Design effective posters collaboratively through creative decisions, give presentations, and efficiently participate in Group discussions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	1	3	1	2	2
CO2	-	-	-	-	-	-	-	2	2	1	3	1	1	2
CO3	-	-	-	-	-	-	-	2	1	1	2	1	1	2
CO4	1	1	1	1	1	1	1	3	3	1	3	2	2	3
CO5	-	1	1	1	1	1	1	3	3	2	3	1	1	2

Exercises

Computer-Aided Language Learning Lab

1. **Introduction to English Phonetics**: Introduction to English Phonetics and organs of speech.
2. **Sound system of English**: Speech sounds- Vowels and Consonants- structure of syllables (Introduction to syllabus) - Basic phonetic transcription practice.
3. **Word and Sentence stress**: Rules of word stress -Primary stress, Secondary stress; Sentence stress (word emphasis in sentences) -Practice.
4. **Intonation**: Types of Intonation, Practice in Articulation – MTI-Errors in pronunciation.
5. **Listening skills**: understanding Listening- Practice in Listening comprehension texts.

Interactive Communication Skills Lab

1. **JAM-** Ice Breaking, Speaking Activity**.**
2. **Role play/Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
3. **Group Discussions -** Dynamics of a Group Discussion, Group Discussion Techniques, Non-Verbal Communication.
4. **Read and Review** - Preparation for active reading and instructing the students to cultivate effective reading habits to read select texts, review and write their responses.
5. **Poster presentation –** Theme, poster preparation, teamwork and presentation.

Textbooks:

1. T Balasubramanian, "A Textbook of English Phonetics for Indian Students", Macmillan, 2nd Edition, 2012.
2. J Sethi et al., "A Practical Course in English Pronunciation (with CD)", Prentice Hall India, 2005.
3. Priyadarshi Patnaik, "Group Discussions and Interview Skills", Cambridge University Press Pvt. Ltd., 2nd Edition, 2015.
4. Aruna Koneru, "Professional Speaking Skills", Oxford University Press, 2018.

Suggested Reading:

1. "English Language Communication Skills – Lab Manual cum Workbook", Cengage Learning India Pvt. Ltd., 2022.
2. KN Shoba & J. Lourdes Javani Rayen. Communicative English – A workbook", Cambridge University Press, 2019.
3. Sanjay Kumar & Pushp. Lata. "Communication Skills: A Workbook. Oxford University Press", 2019.
4. Veerendra Mishra et al. "English Language Skills: A Practical Approach", Cambridge University Press, 2020.

Suggested Software:

1. K-VAN Multi-Media Language Lab
2. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
3. Digital All
4. Orell Digital Language Lab (Licensed Version).

22CSC02N

PROBLEM SOLVING AND PROGRAMMING USING C LAB

Instruction	3 P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives: This course aims to

1. Setting up a programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Identify and set up program development environment.
2. Implement the algorithms using C programming language constructs.
3. Develop programs using arrays, structures and pointers.
4. Solve problems in a modular approach using functions.
5. Implement file operations with simple text data.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	1	1	-	-	-	-	1	-	-	3	3	2
CO2	3	2	1	2	-	-	-	-	-	-	-	3	2	2
CO3	3	2	1	2	-	-	-	-	-	-	-	3	1	2
CO4	3	2	1	2	-	-	-	-	-	-	-	3	3	1
CO5	3	1	-	1	-	-	-	-	-	-	-	3	1	2

LABORATORY / PRACTICAL EXPERIMENTS:

1. Familiarization with programming environment.
2. Draw flowcharts using Raptor or Drakon Tool
3. Simple computational problems using arithmetic expressions.
4. Problems involving if-then-else structures.
5. Iterative problems e.g., sum of series, generating patterns.
6. Iterative and Recursive functions
7. 1D Arrays, 2D arrays and strings.
8. Sorting and Searching, Matrix problems.
9. Pointers and structures.
10. Dynamic memory allocation.
11. File Handling

Textbooks:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e", 2nd Edition, Oxford University Press, 2012.

Suggested Reading:

1. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language", 2nd Edition. Prentice Hall India, 1990.
2. B.A. Forouzan and R.F. Gilberg A Structured Programming Approach in C, Cengage Learning, 2007.
3. Byron Gottfried, Schaum's" Outline of Programming with C", McGraw- Hill.
4. E. Balaguru swamy, Programming in ANSI C, Tata McGraw-Hill.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview.
2. https://archive.nptel.ac.in/courses/106/105/106105171/.

22MEC01N

ENGINEERING GRAPHICS

Instruction	1 T + 3D Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2.5

Prerequisite: Nil

Course Objectives: This course aims to:

1. Get exposure to a cad package and its utility.
2. Understand orthographic projections.
3. Visualize different solids and their sections in orthographic projection
4. Prepare the student to communicate effectively by using isometric projection.
5. Prepare the student to use the techniques, skills, and modern tools necessary for practice.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Become conversant with appropriate use of CAD software for drafting and able to draw conic sections.
2. Understand orthographic projections of points and straight lines.
3. Draw the projections of planes.
4. Draw and analyze the internal details of solids through sectional views.
5. Create an isometric projections and views.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	2	1	2	3	1	3	2	3	1
CO2	3	2	2	1	2	2	1	2	2	1	2	2	2	1
CO3	3	3	2	1	2	2	1	2	2	1	2	2	2	1
CO4	3	3	3	2	2	2	1	2	2	1	2	2	2	1
CO5	3	2	2	1	2	2	1	2	2	1	2	2	3	1

List of Exercises:

1. Introduction to CAD package: Settings draw, modify tools, dimensioning, documentation and practice exercises using Auto CAD software.
2. Construction of Conic Sections by General method.
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane & inclined to both the planes (without traces and mid-point)
5. Projection of planes: Perpendicular planes
6. Projection of planes: Oblique planes
7. Projection of solids: Simple position
8. Projection of solids: Inclined to one plane
9. Sections of solids: Prism, pyramid in simple position
10. Sections of solids: Cone and Cylinder in simple position
11. Isometric projections and views
12. Conversion of isometric views to orthographic projections and vice versa.

Textbooks:

1. N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishers, 2012.
2. K. Venugopal, "Engineering Drawing and Graphics + AutoCAD", New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, "Engineering Drawing", 2/e, McGraw-Hill Education (India) Pvt. Ltd.

Suggested Reading:

1. Shaw M.B and Rana B.C., "Engineering Drawing", 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, "Textbook of Engineering Drawing", SciTech Publications, 2011.

22MEC38N

DIGITAL FABRICATION WORKSHOP

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Give a feel of Engineering Practices and develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive and teamwork attitude to get things right the first time.
3. Provide basic knowledge of steel, plastic, composite, and other materials for suitable applications.
4. Study of principle and hands on practice techniques of fabrication, manufacturing, and allied skills.
5. Advance important, hard and pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand safety measures to be followed in workshops to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	1	-	-	-	1	2	1	1
CO2	1	-	1	-	-	-	-	-	-	-	1	2	1	1
CO3	1	-	1	-	-	1	-	-	-	-	1	3	3	1
CO4	1	-	1	-	-	1	-	-	-	-	1	3	3	2
CO5	2	2	2	1	3	1	1	1	2	-	2	3	2	2

Lab Experiments:

Group 1: Workshop Practice

1. To make a lap joint on the given wooden piece according to the given dimensions
2. To make a dovetail joint on the given wooden piece according to the given dimensions.
3. (a)Wiring of one light point controlled by one single pole switch, a three-pin socket controlled by a single switch.

3 (b)Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three-pin socket.
4 Staircase wiring of one light point controlled from two different places independently using two way switches.
5 To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings, and bends.
6 To connect the GI pipes as per the given diagram using, Coupling, Unions, reducers, and bends. To connect the GI pipes as per the given diagram using shower, tap, and valves and demonstrate by giving water connection.

Group 2: Additive Manufacturing /3D Printing

1. To Study the methods of Additive manufacturing process using a 3D printer.
2. To create 3D CAD model of a door bracket using modeling software.
3. To print a door bracket using an extruder type 3D printer.
4. To create a 3D CAD model using Reverse engineering.
5. Engraving, drilling and Cutting operations on printed circuit boards using CNC PCB Mate.
6. To design an innovative component using CAD software. /print the selected innovative component by the student using a 3D printer.

Textbooks:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Suggested Reading:

1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology.
2. Oliver Bothmann, 3D Printers: A Beginner's Guide, January 1, 2015.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER –II

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC04	Differential Equations & Numerical Methods	3	1	-	3	40	60	4
2	22CYC01	Chemistry	3	-	-	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	-	3	40	60	3
4	22ITC20N	Data Structures using C++	2	1	-	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	-	-	3	3	50	50	1.5
6	22MBC02N	Community Engagement	-	-	2	-	50	-	1
7	22ITC21N	Data Structures using C++ Lab	-	-	2	3	50	50	1
8	22MEC37N	Robotics & Drones Lab	-	1	3	-	100	-	2.5
9	22EEC02	Basic Electrical Engineering Lab	-	-	2	3	50	50	1
10	22ADC05N	Python Programming Lab	-	1	2	3	50	50	2
TOTAL			**10**	**5**	**14**		**510**	**440**	**22**
Clock Hours per week : 29									

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

22MTC04

DIFFERENTIAL EQUATIONS & NUMERICAL METHODS
(AI&DS)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To explain the relevant methods to solve first order differential equations.
2. To explain the relevant methods to solve higher order differential equations.
3. To discuss numerical methods to solve algebraic and transcendental equations.
4. To discuss the interpolation and numerical differentiation.
5. To discuss convergence and divergence of Infinite series.

Course Outcomes:

Upon completing this course, students will be able to:

1. Calculate the solutions of first order linear differential equations.
2. Calculate the solutions of higher order linear differential equations.
3. Solve the algebraic, transcendental and system of equations.
4. Apply interpolation and numerical differentiation techniques for given data.
5. Test the convergence and divergence of Infinite series.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	2	-	1	1
CO2	3	3	3	3	-	-	-	-	-	-	2	-	1	1
CO3	2	2	2	2	-	-	-	-	-	-	1	-	2	2
CO4	2	2	2	2	-	-	-	-	-	-	1	-	2	2
CO5	1	1	1	1	-	-	-	-	-	-	1	-	1	1

UNIT - I

Differential Equations of First Order: Exact Differential Equations, Equations Reducible to Exact Equations, Linear Equations, Bernoulli's Equations, Riccati's and Clairaut's Equations, Orthogonal trajectories, Rate of decay of radio-active materials.

UNIT-II

Higher Order Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of Variation of Parameters, solution of Cauchy- Euler equation. LR and LCR circuits.

UNIT-III

Numerical solution of equations: Numerical solutions of algebraic and transcendental equations by Bisection method, Regula-falsi method and Newton-Raphson's method, Solution of system of linear equations by LU decomposition methods, Crout's method, Jacobi's method, Gauss Seidel method.

UNIT-IV

Interpolation and Numerical Differentiation: Forward, Backward and Central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Lagrange's

interpolation, Numerical differentiation at the tabulated points with forward, backward and central differences.

UNIT-V

Infinite Series: Convergence of sequence and series. Series of positive terms, Necessary condition for convergence, Comparison tests, limit form comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's rule, absolutely and conditionally convergence.

Textbooks:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2011.
3. M.K. Jain, S.R.K Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering and Computation", New age International Publications, 2008.

Suggested Reading:

1. R.K.Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics",5th edition, Narosa Publications, 2016.
2. Ramana B.V, "Higher Engineering Mathematics",11th Reprint, Tata McGraw Hill New Delhi, 2010.
3. A.R.Vasishtha and R.K.Guptha, "Integral Transforms", Reprint, Krishna's Educational Publishers, 2014.

Online Resources:

Course Code	Course Name	Resource Link
22MTC04	Differential Equations and Numerical Methods	1. NPTEL :: Mathematics - NOC:Advanced Calculus For Engineers (Week 5 & Week 6) 2. https://archive.nptel.ac.in/courses/111/107/111107105/ (Unit- 1,2,4 and 5) 3. https://archive.nptel.ac.in/courses/111/104/111104085/ (Infinite Series)

22CYC01

CHEMISTRY

Instruction:	3L Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits:	3

Course Objectives
This course aims to

1. Develop the concepts of chemical bonding and chemical kinetics
2. Provide conceptual knowledge about spontaneity terms of thermodynamics and applications of electrochemical cell & batteries.
3. Give an insight of stereochemistry and various types of organic reactions
4. Impart theoretical knowledge, determination & softening of water in domestic & industrial use.
5. Acquire the knowledge on Polymers, nanomaterial's and basic drugs of modern chemistry.

Course Outcomes
At the end of the course student will be able to:

1. Identify the bond order & magnetic properties of various molecules and rate of chemical reactions.
2. Discuss the properties using thermodynamic functions and role of cells in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for both domestic and industrial use.
5. Demonstrate the synthesis of various Engineering materials & Drugs.
6.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO2	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO3	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO4	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO5	3	2	2	-	-	2	-	-	-	-	2	-	-	-

UNIT-I Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2, He_2^+, N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numerical.

UNIT-II Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz

equations and its applications). Cell potentials, electrode potentials, and – Reference electrodes (NHE, SCE) electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.
Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.
Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III Stereochemistry and Organic reactions
Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) &Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.
Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)
Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)
Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides), Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:
Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V Engineering Materials and Drugs:
Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.
Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography
Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).
Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXTBOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla ,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley,12th edition (2017).

4. P.W. Atkins, J.D. Paula, “Physical Chemistry”, Oxford, 8th edition (2006).

22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To understand the behavior of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis.
2. To comprehend the basic principle of operation of AC and DC machines.
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

Course Outcomes:

After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single-phase transformers.
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthling, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	1	2	-	3	1	1	-
CO2	3	3	2	-	-	-	-	1	2	-	3	1	1	-
CO3	3	3	2	1	-	-	-	1	2	-	3	1	1	-
CO4	2	1	-	-	-	-	-	1	2	-	3	1	1	-
CO5	2	-	2	-	-	-	-	1	2	-	3	1	1	-

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, The venin's and Norton's Theorems.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

Textbooks:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

Suggested Reading:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering " Cengage Learning, 1st Edition, 2013.

22ITC20N

DATA STRUCTURES USING C++

Instruction	2L+1THours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Problem Solving and Programming using C (22CSC01N), Problem Solving and Programming using C Lab (22CSC02N)

Course Objectives: The objectives of this course are to:

1. Acquaint with OOP concepts.
2. Familiarize with the asymptotic analysis of Algorithms.
3. Learn sorting techniques.
4. Explore linear and nonlinear data structures.
5. Introduce pattern-matching algorithms and hashing.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the concepts of OOPs.
2. Analyse the time complexity of operations on data structures.
3. Apply sorting techniques, pattern-matching algorithms, and hashing.
4. Demonstrate operations on linear and nonlinear data structures.
5. Develop solutions to the problems using linear and nonlinear data structures.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	0	1	0	0	0	0	0	1	2	3	1
CO2	2	2	2	0	1	0	0	0	0	0	1	3	2	2
CO3	2	2	2	0	1	0	0	0	0	0	1	3	3	2
CO4	2	3	2	0	1	0	0	0	0	0	1	3	3	2
CO5	2	3	2	0	1	0	0	0	0	0	1	3	3	2

UNIT I:

Object Oriented Design: Object-Oriented Design Goals, Object-Oriented Design Principles, Classes: Class Structure, Constructors and Destructor, Classes and Memory Allocation, Class Friends and Class Members, Standard Template Library; Inheritance: Inheritance in C++, Examples, Multiple Inheritance, Interfaces and Abstract Classes, Templates: Class Templates

UNIT II:

Algorithm Analysis: Experimental Studies, Primitive Operations, Asymptotic notation, Asymptotic Analysis, Seven functions.

Sorting: Selection Sort, Insertion Sort, Merge-Sort: Divide-and-Conquer, Quick-Sort: Randomized Quick-Sort, Linear-Time Sorting: Bucket-Sort and Radix-Sort, Comparing Sorting Algorithms.

UNIT III:

Linked Lists: Singly Linked Lists, Implementing a Singly Linked List, Insertion to the Front of a Singly Linked List, Removal from the Front of a Singly Linked List, Implementing a Generic Singly Linked List, Doubly Linked Lists, Insertion into a Doubly Linked List, Removal from a Doubly Linked List, Circularly Linked Lists, Reversing a Linked List.

Stacks: The Stack Abstract Data Type, A C++ Stack Interface, A Simple Array-Based Stack Implementation, Reversing a Vector Using a Stack, Matching Parentheses; **Queues:** The Queue Abstract Data Type, A C++ Queue Interface, A Simple Array-Based Implementation, Implementing a Queue with a Circularly Linked List

UNIT IV:

Trees: General Tree Definitions and Properties, Binary Trees, The Binary Tree ADT, Properties of Binary Trees, A Linked Structure for Binary Trees, A Vector-Based Structure for Binary Trees, Traversals of a Binary Tree, Representing General Trees with Binary Trees, **Binary Search Trees:** Searching, Update Operations, AVL Trees: Insertion; **Heaps:** The Heap Data Structure, Complete Binary Trees, Heap Sort.

UNIT V:

Strings: Pattern Matching Algorithms: Brute Force, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm

Graphs: Graphs, Data Structures for Graph, Graph Traversals

Hash Tables: Hash Tables, Bucket Arrays, Hash Functions, Hash Codes, Compression functions, Collision-Handling Schemes, Load Factors and Rehashing

Textbooks:

1. Michael T.Goodrich, Roberto Tamassia, David M.Mount, "Data Structure and Algorithms in C++", 2nd Edition, John Wiley, 2011.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Career Monk Publications, 5th Edition, 2017.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++" 2nd Edition, Universities Press, 2007

Suggested Reading:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Addison-Wesley, 2007.
2. Narasimha Karumanchi, "Data Structures and Algorithms for GATE", Career Monk Publications, 2011.
3. D. Samantha, "Classic Data Structures", Prentice Hall India, 2nd Edition, 2013.

Online Resources:

1. NPTEL Videos: Introduction to data structures and algorithms - http://nptel.ac.in/courses/106102064/1
2. https://takeuforward.org/strivers-a2z-dsa-course/strivers-a2z-dsa-course-sheet-2/
3. https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html.
5. https://visualgo.net/en

22CYC02

CHEMISTRY LAB

Instruction:	3P Hours per Week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	50 Marks
Continuous Internal Evaluation:	50 Marks
Credits:	1.5

Course Objectives

This course aims to

1. Impart fundamental knowledge in handling the equipment/glassware and chemicals in chemistry laboratory.
2. Provide the knowledge in both qualitative and quantitative chemical analysis
3. Get familiarized with the principles of volumetric analysis
4. Understand & use the various instrumental methods to analyse the chemical compounds
5. Interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes

At the end of the course student will be able to:

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO2	3	2	1	-	-	2	-	-	-	-	2	-	-	-
CO3	3	2	3	-	-	2	-	-	-	-	2	-	-	-
CO4	3	2	2	-	-	2	-	-	-	-	2	-	-	-
CO5	3	2	3	-	-	2	-	-	-	-	2	-	-	-

Chemistry Lab

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (Second order)
7. Estimation of amount of HCl Conduct metrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conduct metrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.

12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

TEXTBOOKS

1. J. Mendham and Thomas, "Vogel's textbook of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati,; R. Chand & Co.: New Delhi (2011).

SUGGESTED READINGS

1. Dr. Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara, "A Textbook on experiment and calculation in engineering chemistry", S. Chand and Company, 9th revised edition, 2015.

22MBC02N
COMMUNITY ENGAGEMENT

Instruction	2P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. Develop an appreciation of Rural culture, lifestyle and wisdom among the students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

Course Outcomes:

After the completion of this Course, Student will be able to:

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilize the opportunities provided by Rural Development Programmes.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
C01	1	2	2	2	-	3	1	2	-	-	2	2	3	1
CO2	-	1	2	2	-	2	-	2	1	-	1	3	2	2
CO3	-	1	1	2	-	3	1	3	1	2	1	3	3	2
CO4	2	2	3	2	-	2	1	2	2	1	-	3	3	2
CO5	1	2	2	1	-	2	-	1	-	1	1	3	3	2

Module I Appreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes

History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralized Planning, NRLM, MNREGA etc.

Textbooks:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Handbook on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journal of Rural Development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

22ITC21N

DATA STRUCTURES USING C++ LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3Hours
Semester End Examination	50Marks
CIE	50Marks
Credits	1

Prerequisites: Problem Solving and Programming using C (22CSC01N), Problem Solving and Programming using C Lab (22CSC02N)

Course Objectives: The objectives of this course are to:

1. Acquaint with OOP concepts.
2. Learn sorting techniques.
3. Explore linear and nonlinear data structures.
4. Introduce pattern-matching algorithms
5. Explain hashing and Collision handling.

Course Outcomes: After completion of the course, students will be able to:

1. Practice the concepts of OOPs.
2. Define ADT for linear and nonlinear Data Structures.
3. Apply sorting techniques, pattern matching algorithm, and hashing.
4. Demonstrate standard operations on linear and nonlinear data structures.
5. Develop solutions to the problems using linear and nonlinear data structures.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2	0	1	0	0	0	0	0	1	2	3	1
CO2	2	2	2	0	1	0	0	0	0	0	1	3	2	2
CO3	2	2	2	0	1	0	0	0	0	0	1	3	3	2
CO4	2	2	2	0	1	0	0	0	0	0	1	3	3	2
CO5	2	2	2	0	1	0	0	0	0	0	1	3	3	2

List of Programs

1. Practice problems on Inheritance and Polymorphism
2. Implement the following sorting techniques: Insertion Sort, Selection Sort, Merge Sort, Quick Sort.
3. Define Linked List ADT and implement its operations.
4. Implement Stack ADT and perform arithmetic expression evaluation.
5. Implement Queues, Circular Queues.
6. Implement Heap sort.
7. Construct a Binary Search Tree and implement Tree Traversals.
8. Define String ADT and implement the Boyer Moore pattern matching algorithm.
9. Implement Hashing with chaining.
10. Implement Graph Traversals.

Textbooks:

1. Michael T.Goodrich, Roberto Tamassia, David M.Mount, "Data Structure and Algorithms in C++", 2nd Edition, John Wiley, 2011.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Career Monk Publications, 5th Edition, 2017.

3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C++" 2nd Edition, Universities Press, 2007

Suggested Reading:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3rd Edition, Addison-Wesley, 2007.
2. D.Samantha, "Classic Data Structures", Prentice Hall India, 2nd Edition,2013.

Online Resources:

1. https://takeuforward.org/strivers-a2z-dsa-course/strivers-a2z-dsa-course-sheet-2/
2. https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/

22MEC37N

ROBOTICS AND DRONES LAB

Instruction	1T + 3P Hours per week
Duration of SEE	-
SEE	-
CIE	100 Marks
Credits	2.5

Prerequisite: Nil

Course Objectives:

The objectives of this course are to:

1. To develop a thorough understanding of various autonomous robot structures
2. To gain expertise in working with various sensors and gain the ability to interface sensors with microcontrollers, read data, and seamlessly integrate them into robotics applications.
3. To acquire proficiency in understanding different types of motors, motor drivers, develop the skills to interface motors with microcontrollers, motors and construct two-wheel robots with controlled movements.
4. To attain proficiency in utilizing OpenCV for advanced image processing tasks master techniques such as RGB value extraction, creating colored shapes, and extracting Regions of Interest (ROI) from images.
5. To develop a thorough understanding of various drone structures/develop autonomous systems.

Course Outcomes:

After completion of course, students would be able to:

1. Understand mechanical structures, motors, sensors, and circuits essential for constructing robots.
2. Demonstrate the utilization of sensors (Ultrasonic, IR, Rotary Encoder) for Arduino interfacing, reading data, and integrating them seamlessly into robotics applications.
3. Demonstrate expertise in operating robot controllers, applying theory to precisely control servo and stepper motors, 2-wheel robots ensuring desired motion.
4. Able to apply Python and OpenCV for image processing, including RGB extraction and ROI tasks.
5. Proficiently assemble a quad copter drone, showcasing understanding of its classification, parts, and operational principles/ Proficiency to develop autonomous systems fostering creativity and practical application.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	1	3	3	1	2	2	3	1
CO2	1	2	2	1	1	-	1	3	3	1	2	3	2	2
CO3	1	2	2	1	1	-	1	3	3	1	2	3	3	2
CO4	2	2	2	1	1	-	1	3	3	1	2	3	3	2
CO5	2	2	2	1	1	-	1	3	3	1	2	3	3	2

Lab Experiments:

Experiment No	Title	CO
1.	Introduction to Robotics, Definition and scope of robotics, Robot Configurations-Cartesian, cylinder, polar and articulate. Uses and Significance of Robots, Parts of a Robot, Current applications and future trends.	1

	Introduction to Arduino, C++, Arduino Programming Environment. Interfacing Arduino with Electronic Devices such as LEDs/Piezo Buzzer	
2.	Interfacing Arduino with Electronic Devices such as Push Button/Potentiometer	1
3.	Introduction to Sensors, Types of Sensors, Reading Data from Sensors, Interfacing Sensors with Microcontrollers. Interfacing Arduino with Ultrasonic Distance Sensor and Reading Sensor Data on Serial Monitor	2
4.	Interfacing Arduino with IR Sensor and Reading Sensor Data on Serial Monitor	2
5.	Interfacing Arduino with Rotary Encoder and Reading Sensor Data on Serial Monitor	2
6.	Introduction to motors, Types of motors, Motor drivers, Interfacing motors with Microcontrollers, Introduction to Li-ion, LIPO batteries, uses and safety precaution. Implement a system that utilizes an Arduino microcontroller to control the precise movement of a servo motor.	3
7.	Implement a system that utilizes an Arduino microcontroller to control the precise and sequential movements of a stepper motor.	3
8.	Construct a two-wheel robot using DC motors controlled by an Arduino microcontroller. Implement a program that allows the robot to execute specific movements. The robot should: i. Move forward with controlled acceleration. ii. Move backward with controlled deceleration.	3
9.	Construct an Obstacle avoidance robot	3
10.	Construct a Pick and place robot	3
11.	OpenCv for image processing: i. Extraction of RGB values of a pixel ii. Create colored shapes and save image iii. Extraction of ROI	4
12.	Assembly of quad copter drone.	5

Open-Ended Project on Autonomous System

Note:

- Mandatory Open-Ended Project (20 marks) in CIE.
- Any 10 experiments the students must do among the 12 experiments.

Suggested Readings:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies- forecasts- players/584
4. https://dronebotworkshop.com/

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

Course Outcomes:

After the completion of this course, the student will be able to:

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	-	-	-	-	2	1	1	-
CO2	3	2	1	-	-	2	-	-	-	-	2	1	1	-
CO3	3	2	3	-	-	2	-	-	-	-	2	1	1	-
CO4	3	2	2	-	-	2	-	-	-	-	2	1	1	-
CO5	3	2	3	-	-	2	-	-	-	-	2	1	1	-

List of Laboratory Experiments/Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using

(i) 3-Ammeter method (ii) 3-Voltmeter method

8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes

22ADC05N

PYTHON PROGRAMMING LAB

Instruction	1T + 2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2

Prerequisite: Programming for Problem Solving

Course Objectives:

This course aims to:

1. Introduce the fundamentals of writing Python scripts
2. Familiarize with Python variables, flow controls structures, and functions.
3. Equip students with the knowledge to select and work with appropriate data structures (lists, tuples, and dictionaries) to efficiently organize and manipulate data.
4. Emphasize the importance of modularity and reusability by teaching students how to design well- structured programs using functions.
5. Enable students to confidently read data from external files, process it in Python, and write results back to files for storage and analysis.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate a solid understanding of basic Python syntax, variables, data types (integers, floats, strings, Boolean), and operators.
2. Construct programs that effectively utilize conditional statements (if, elif, else) and looping structures (for, while) to control program execution.
3. Choose and manipulate suitable data structures (lists, tuples, and dictionaries) and files to effectively store, organize, and manage data within Python programs.
4. Write modular and well-structured code by defining and using functions with appropriate parameters and return values.
5. Design and implement modular Python code using packages, sub packages and functions to enhance code organization, reusability and maintainability.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	-	-	-	-	-	1	3	3	3
CO2	2	3	3	3	3	-	-	-	-	-	1	3	3	3
CO3	2	3	3	3	3	-	-	-	-	-	1	3	3	3
CO4	2	3	3	3	3	-	-	-	-	-	1	3	3	3
CO5	2	3	3	3	3	-	-	-	-	-	1	3	3	3

List of Experiments:

1. Set up your Python environment, write your first "Hello, World!" program, and experiment with basic print statements and calculations.
2. Write Python programs to work with different data types (integers, floats, strings, Booleans) and use operators to perform calculations and manipulate text.
3. Create programs that utilize conditional statements (if, elif, else) to control the flow of execution based on different conditions. Define functions with parameters and return values to break down code into manageable and reusable blocks.

4. Create and manipulate lists and tuples to store and manage ordered collections of data.
5. Leverage dictionaries to store and retrieve data efficiently using key-value associations.
6. Write programs to open, read from, and write to text files in Python for persistent data storage.
7. Design a simple class hierarchy (e.g., animals, shapes, vehicles) where you define classes, create objects, and demonstrate inheritance with methods and attributes.
8. Write Python scripts to handle exceptions.
9. Create a simple GUI with Tkinter library.
10. Design and build a small-scale Python project that demonstrates your understanding of core Python principles. Organize your code with modules, packages and subpackages.

Text Books:

1. R.S. Salaria, "Programming in Python", Khanna Book Publishing Co., Delhi.
2. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.

Suggested Reading:

1. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Book Publishing Co., Delhi.
2. Mark Lutz, "Learning Python", 5th Edition, , O'Reilly Media, Inc.,

Web Resources:

1. https://docs.python.org/3/tutorial/index.html
2. https://realpython.com/

Practice & Challenges:

1. https://www.hackerrank.com/
2. https://exercism.org/

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – III

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	22MTC07	Mathematical and Statistical Foundations	3	-	3	40	60	3
2.	22ITC05N	Discrete Mathematics	3	-	3	40	60	3
3.	22ADC31N	Exploratory Data Analysis and Visualization	2	-	3	40	60	2
4.	22ITC02N	Java Programming	3	-	3	40	60	3
5.	22ITC01N	Digital Logic and Computer Architecture	3	-	3	40	60	3
6.	22CSC14N	Design and Analysis of Algorithms	3	-	3	40	60	3
7.	22EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	Non-Credit
PRACTICAL								
8.	22ADC32N	Exploratory Data Analysis and Visualization Lab	-	2	3	50	50	1
9.	22ITC03N	Java Programming Lab	-	3	3	50	50	1.5
10.	22ADC33N	Competitive Programming	-	2	-	50	-	1
11.	22ADI01	MOOCs/Training/Internship	3-4 Weeks/ 90 Hours		-	50	-	2
TOTAL			**19**	**7**		**440**	**510**	**22.5**
Clock Hours per week: 26								

L: Lecture **D: Drawing** **CIE - Continuous Internal Evaluation**

T: Tutorial **P: Practical** **SEE: Semester End Examination**

22MTC07

MATHEMATICAL AND STATISTICAL FOUNDATIONS

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3
Prerequisites:	

Course Objectives:

1. Able to learn and Analysing data in using statistical tools.
2. Able to fit the hypothetical data using probability distribution.
3. Able to fit the random data using distribution function.
4. Able to understand the data using the testing of Hypothesis.
5. Able to understand the basic concepts of the Number Theory for data security.
6.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Apply the statistical averages for identifying behaviour of the data.
2. Analyse the data using probabilistic models.
3. Apply the probability function to characterise the random phenomenon.
4. Analyse data using different methods of hypothesis testing.
5. Apply the number theory concept to cryptography domain.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	2	2	2	3
CO2	3	3	2	2	-	-	-	-	-	-	2	2	2	2
CO3	3	3	2	2	-	-	-	-	-	-	2	2	2	2
CO4	3	3	2	2	-	-	-	-	-	-	2	2	2	3
CO5	3	3	2	2	-	-	-	-	-	-	2	1	2	1

UNIT-I: Basic Statistics

Measures of Central Tendency, Measures of Dispersion, Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, linear regression, properties of regression coefficient.

UNIT-II: Mathematical Expectation (One Dimensional Random variables)

Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, Variance and co-variance. Moments (Moments about the mean and moments about a point).

UNIT-III: Probability Distributions

Poisson distribution, Mean, Variance, MGF and CGF, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution). Normal distribution, Characteristics of normal distribution, Mean, Variance, MGF and CGF, Areas under normal curve. Uniform distribution, Mean, Variance and MGF, Exponential distribution, Mean, Variance, MGF and CGF.

UNIT-IV: Testing of Hypothesis

Large and Small Sample Tests: Tests of significance for large samples, for Single Proportion, difference of Proportions, Single mean and difference of means. Small sample test: t-test for single mean and differences of means. F-test for equality of two population variances.

UNIT-V: Number Theory

Greatest common divisors, The Euclidean algorithm, the fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers. Introduction to Congruence, Linear congruence, The Chinese Remainder Theorem, System of linear congruences.

Textbooks:

1. 1.S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Kenneth H. Rosen, Elementary number theory & its applications, Sixth edition, Addison-wesley, ISBN978 0-321-50031-1.

Suggested Reading:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.
3. S.C.Gupta, V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, 2014.

Online Resources:

Course Code	Course Name		Resource Links
22MTC07	Mathematical and Statistical Foundation	1.	2. https://archive.nptel.ac.in/courses/110/107/110107114/ 3. https://archive.nptel.ac.in/courses/111/101/111101137/ (Week 1,2,4,5 &7)

22ITC05N

DISCRETE MATHEMATICS

(Common to CSE-AIML, AIML, AI&DS, CET and IT branches)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to

1. Introduce Propositional, Predicate Logic and various proof techniques for validation of arguments.
2. Develop an understanding of counting, functions and relations.
3. Familiarize with fundamental notions and applicability of graph theory and algebraic systems

COURSE OUTCOMES:

After completion of this course, students will be able to

1. Describe rules of inference for Propositional and Predicate logic.
2. Demonstrate use of Set Theory, Venn Diagrams, and relations in Real-world scenarios.
3. Model solutions using Generating Functions and Recurrence Relations.
4. Determine the properties of graphs and trees to solve problems arising in computer science applications.
5. Distinguish between groups, semi groups and monoids in algebraic systems

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	-	-	-	2	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	-	-	1	1	2	3
CO3	2	3	1	3	1	-	-	-	-	-	-	-	-	-
CO4	3	3	2	3	1	-	-	-	-	-	1	2	2	2
CO5	3	3	1	1	-	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction to Propositional Calculus: Basic Connectives and Truth tables, Logical Equivalence: Laws of Logic, Logical Implication; Rules of Inference. **Predicates**: The Use of Quantifiers, Definitions and the Proofs of Theorems

UNIT-II

Sets: Sets and Subsets, Operations on sets and the Laws of Set Theory, Counting and Venn Diagrams. **Relations**: Cartesian Products and Relations. Partial ordering relations, POSET, Hasse diagrams, Lattices as Partially Ordered Sets, Equivalence relations. Pigeonhole principle.

UNIT-III

Generating Functions: Generating Functions, Calculating Coefficient of generating functions.

Recurrence Relations: The First Order Linear Recurrence Relation, Second Order Linear. Homogeneous Recurrence relations with constant coefficients, Non-Homogeneous Recurrence relations.

UNIT-IV

Introduction to Graphs: Graphs and their basic properties- degree, path, cycle, Sub graphs, Complements and Graph Isomorphism, Euler trails and circuits, Hamiltonian paths and cycles, planar graphs, Euler formula, Graph Coloring.

Trees: Definitions, Properties, Spanning Trees, **Minimum Spanning trees**: The Algorithms of Kruskal and Prim

UNIT-V

Algebraic Structures: Algebraic Systems, Examples and General Properties, Semi groups and Monoids.

Groups: Definitions and Examples, Subgroups, Homomorphisms and cyclic groups

TEXTBOOKS:

1. Rosen, K. H. (2019). Discrete Mathematics and Its Applications. (8th Edition) ISBN10: 125967651X ISBN13: 9781259676512(latest edition)
2. Oscar Levin Discrete Mathematics An Open Introduction (4th Edition) ISBN 9781032966168 2025**,** CRC Press.
3. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", TATA Mc Graw-Hill Edition, 1995.

SUGGESTED READING:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", An Applied Introduction, 5th edition, Pearson Education, 2016. (latest edition)
2. Singh, S.B., Discrete Mathematics, Khanna Book Publishing Company, New Delhi. SBN: 9789382609407, 9789382609407 Edition: 3, 2019 (latest edition)
3. David D. Railey, Kenny A. Hunt, "Computational Thinking for the Modern Problem Solving", CRC Press, 2014
4. Joe L. Mott, Abraham Kandel, Theodore P. Baker, "Discrete Mathematics for Computer Scientists & Mathematicians", 8th Edition, PHI, 1986.

WEB RESOURCES:

1. https://nptel.ac.in/courses/111107058/
2. https://nptel-discrete-mathematics-5217

22ADC31N

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

Instruction	2L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

PREREQUISITE: Python Programming

Course Objectives: This course aims to:

1. Introduce the fundamentals of NumPy, including array creation, manipulation, and mathematical operations, to build a strong foundation for numerical computing in Python.
2. Familiarize students with core Pandas data structures and operations for loading, manipulating, and summarizing structured datasets.
3. Teach essential data preprocessing techniques such as handling missing values, transforming data, and combining datasets using Pandas for real-world data analysis.
4. Explain methods for data aggregation and grouping along with time series handling to manage, analyze, and interpret time-dependent data effectively.
5. Develop skills in data visualization using Matplotlib and Seaborn to present analytical results clearly through various types of charts and plots.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply NumPy operations such as array creation, indexing, arithmetic computations, transposition, and random number generation to efficiently perform numerical and data manipulation tasks.
2. Perform data manipulation, analysis, and summarization on structured data by utilizing Pandas data structures and functionalities.
3. Apply data cleaning and wrangling techniques using Pandas to handle missing data, transform and categorize values, perform hierarchical indexing, merge and reshape datasets, and prepare data for meaningful analysis.
4. Summarize and analyze data using group operations, and handle time series data by converting dates, selecting time-based data, and performing resampling and frequency changes with Pandas.
5. Create and customize a variety of visualizations using Matplotlib and Seaborn, including line plots, bar charts, histograms, scatter plots, and categorical plots, to effectively communicate data insights.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	-	-	-	-	-	2	1	1	2
CO2	3	2	-	1	2	-	-	-	1	-	2	2	1	3
CO3	3	2	-	1	2	-	-	-	1	-	2	2	1	2
CO4	3	2	-	2	2	-	-	-	1	-	2	1	1	2
CO5	1	1	-	1	2	-	-	-	2	-	2	1	1	2

UNIT - I

NumPy Basics: Creating ND arrays, Data Types for ND arrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Pseudo Random Number Generation, Universal Functions.

UNIT - II

Getting Started with Pandas: Series, Data Frame and Index Objects, Reindexing, Dropping Entries from an Axis, Indexing, Selection and Filtering, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels, Summarizing and Computing Descriptive Statistics.
Data Loading, Storage and File Formats: Reading Text Files in Pieces, Writing Data to Text Format.

UNIT - III

Data Cleaning and Preparation: Filtering out Missing Data, Filling in Missing Data, Transforming Data using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering, Categorical Extension Type in Pandas, Computations with Categoricals.

Data Wrangling: Hierarchical Indexing-Reordering and Sorting Levels, Summary Statistics by Level, Indexing with a Data Frame's Columns, Database-Style Data Frame Joins, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap, Reshaping with Hierarchical Indexing.

UNIT - IV

Data Aggregation and Group Operations: Column-Wise and Multiple Function Application, Returning Aggregated Data without Row Indexes, General Split-apply-combine.
Time Series: Date and Time Data Types and Tools, Converting between String and Date time, Time Series Basics-Indexing, Selection, Subsetting, Time Series with Duplicate Indices, Generating Date ranges, Frequencies and Dateoffsets, Resampling and Frequency Conversion-Down Sampling, Up sampling and Interpolation.

UNIT - V

Plotting and Visualization: Figures and Subplots, Colors, Markers and Line styles, Ticks, Labels and Legends, Saving Plots to File, Seaborne - Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots, Facet Grids and Categorical Data.

TEXTBOOKS:

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, 2022

SUGGESTED READING:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.

WEB RESOURCES:

1. https://numpy.org/doc/stable/user/index.html
2. https://pandas.pydata.org/
3. https://matplotlib.org/
4. https://seaborn.pydata.org/tutorial.html
5. https://www.coursera.org/learn/data-analysis-with-python

22ITC02N

JAVA PROGRAMMING

(Common to CSE, IT, AI&DS, CET and allied branches)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CI E	40 Marks
Credits	3

Course Objectives

The course aims to:

1. Introduce the fundamental concepts of Object-Oriented Programming (OOP).
2. Guide students through the process of creating and managing classes and objects.
3. Explain and demonstrate the use of inheritance and polymorphism.
4. Teach effective handling of runtime exceptions and the basics of multithreading.
5. Provide hands-on experience with Java's IO package for application development.

Course Outcomes

By the end of this course, students will be able to:

1. Apply OOP concepts to develop structured Java applications.
2. Utilize inheritance and interfaces to enhance code reusability and flexibility.
3. Implement exception handling and multithreading to manage complex program flows.
4. Build applications using the Java Collection Framework.
5. Develop programs that handle input and output operations using the IO package.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2
CO2	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO5	2	2	3	2	3	1	-	1	2	1	2	2	3	3

UNIT-I

Introduction to Java: Procedural and object-oriented programming paradigms, Principles, Features, Basic structure a java program, Java Primitive Data Types, Basic Operators, Flow-control statements. Defining Classes, Adding Instance Fields and Methods, Object Creation, Constructors, Access Modifiers, Method Overloading and Constructor Overloading, Use of static and final keyword, Arrays, Strings and String Tokenizer, Scanner.

UNIT-II

Inheritances and Packages: Types of Inheritance, super keyword, preventing inheritance, the Object class, method overriding and dynamic method dispatch, abstract classes and methods. Interfaces, Interfaces vs. Abstract classes, Inner classes and types, Packages, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT-III

Exception Handling and Threading: What are exceptions, Error vs. Exception, usage of try, catch, throw,

throws and finally clauses, Multithreading in Java, Life cycle of Thread, how to create threads, Thread class in java, Thread priorities, Thread Synchronization. Introduction to Generics, Advantages of Generics, Generic class, Type Parameters, Generic Methods.

UNIT-IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Collection classes – Array List, Linked List, Hash Set, Tree Set, Hash Map, Tree Map, Iteration over Collections – Iterator and List Iterator, Comparable and Comparator interface, Introduction to Java 8 Features, Lambda Expressions, Functional Interfaces.

UNIT-V

Java I/O and NIO: Input Stream, Output Stream, Reader, Writer, File Reader, File Writer, Buffered Reader, Buffered Writer, Object Serialization and Deserialization, Java NIO: Non-blocking I/O, Path, Files, Selectors, Channels, Buffers, Asynchronous I/O, NIO vs. IO

Textbooks:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.

Suggested Reading:

1. E Balaguruswamy "Programming with Java", Tata McGraw-Hill, 6th Edition, 2019.
2. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition. 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22ITC01N DIGITAL LOGIC AND COMPUTER ARCHITECTURE

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with Data representation, Number system and Logic gates.
2. To provide understanding of Combinational and Sequential logic circuits, Digital Registers and Counters.
3. To present the operation of the Central Processing Unit.
4. To facilitate the techniques that computers use to communicate with input and output devices.
5. To introduce the concept of memory hierarchy and memory management.

Course Outcomes: Upon completing this course, students will be able to:

1. Apply Boolean algebra for simplification and learn representation of data using numbers.
2. Understand fundamentals of Combinational & Sequential logic gates, registers and counters.
3. Infer the architecture and functionality of the central processing unit.
4. Explore the techniques that computers use to communicate with I/O devices for data transfer.
5. Comprehend memory hierarchy, cache memory and virtual memory.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	0	1	0	0	0	1	0	0	2	0	2
CO2	2	2	1	0	1	0	0	0	0	0	0	1	0	2
CO3	2	2	1	0	0	0	0	0	0	0	2	0	0	2
CO4	2	1	0	0	0	0	0	0	0	0	0	0	0	2
CO5	2	2	1	0	0	0	1	0	1	0	2	1	0	2

UNIT–I

Data Representation: Number Systems, Octal, binary, Hexadecimal and Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers.

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map simplification, Sum-of-Products and Product-of-sums Simplification, Don't -Care Conditions.

UNIT–II

Combinational Circuits: Decoders, Encoders, Multiplexers, Half-Adder, Full-Adders.

Flip-Flops: SR, D, JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

Registers: Register with Parallel load, Bidirectional Shift Register with Parallel load, 4-bit Synchronous Binary Counter.

UNIT-III

Central Processing Unit: Computer Registers, General register Organization, Instruction Cycle and Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions, Zero-Address Instructions, RISC Instructions, Addressing Modes, Data Transfer and Manipulation, Program Control.

UNIT-IV

Input-Output Organization: Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, Modes of Transfer, Interrupt-

Initiated I/O, Priority Interrupt: Daisy Chaining Priority, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access(DMA): DMA Controller.

UNIT- V

Memory Organization: Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, Associative Memory: Hardware Organization, Cache Memory: Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space.

Textbook:

1 M.Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education. 2016.

References:

1. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", 2nd Edition, McGraw Hill, 2009.
2. ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill, 1995.
3. William Stallings, "Computer Organization and Architecture", 8th Edition,PHI.2010
4. Carl Hamachar, Vranesic, Zaky, "Computer Organization", 5th Edition, McGraw Hill.2002.

Web Resources:

1. https://nptel.ac.in/courses/108105132
2. https://nptel.ac.in/courses/106105163

22CSC14N

DESIGN AND ANALYSIS OF ALGORITHMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basics of Data structures and algorithms.

Course Objectives:

This course aims to:

1. Provide an introduction to formalisms to understand, analyse and denote time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.
3. Provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Identify and apply asymptotic notations and recurrence-solving techniques to analyse the performance of recursive algorithms
2. Apply greedy and dynamic programming strategies to solve optimization problems and identify the most suitable design approach based on problem characteristics.
3. Implement backtracking and branch-and-bound techniques to solve combinatorial and decision problems and evaluate their efficiency.
4. Solve and evaluate the performance of graph traversal and shortest path algorithms.
5. Demonstrate NP-completeness through problem reductions and complexity classes.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	-	-	-	-	-	-	2	3	2
CO2	3	3	2	-	2	-	-	-	-	-	-	3	3	2
CO3	3	3	2	-	2	-	-	-	-	-	-	3	3	2
CO4	3	3	-	-	2	-	-	-	-	-	-	3	3	2
CO5	2	3	-	-	2	-	-	-	-	-	-	2	2	3

UNIT - I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst-case behaviour. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method, Minimum and Maximum Problem **Analysis of recursive algorithms through recurrence relations:** Iterative/Expansion method, Recursion tree method and Masters' theorem.

UNIT - II

Greedy Algorithms: The general method, Knapsack Problem, Huffman Codes, Job scheduling with deadlines. **Dynamic Programming**: The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix chain multiplication, Longest Common subsequence.

UNIT - III

Backtracking: The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound**: The general method, FIFO branch and bound, LC branch and bound, 0/1 Knapsack Problem using FIFO branch and bound, Travelling Salesperson problem using LC branch and bound.

UNIT - IV

Graph Algorithms: Applications of DFS: Bi-Connected components, strongly connected components, topological sorting. **Shortest Path Algorithms**: Dijkstra's, Bellman-Ford, Floyd-Warshall

UNIT - V

Theory of NP-Completeness: Polynomial time, Polynomial time verification, P, NP, NP-hard and NP-Complete classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, Vertex-Cover Problem.

Textbooks:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 4th Edition, 2022.
2. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2008.

Suggested Reading:

1. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis", and Internet Examples, Wiley Second Edition.

Online Resources:

1. https://nptel.ac.in/courses/106101060/

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/BTech III/IV/VI/VII Semester - Common to all branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	----
Credits	0

Prerequisite: Basic awareness of Indian Constitution and Government.

Course Objectives

The course will introduce the students to:

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

Course Outcomes

After successful completion of the course the students will be able to:

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	1	1	-	-	-	1	-	-
CO2	-	-	2	-	-	3	2	1	-	-	-	2	-	-
CO3	-	-	1	-	-	1	-	-	-	-	-	-	-	-
CO4	-	-	1	-	-	1	-	-	-	-	-	1	-	-
CO5	-	-	2	-	-	3	1	1	-	-	-	2	-	-

Unit-I

Constitutional History and Framing of Indian Constitution

East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

Unit-II

Fundamental Rights, Duties and Directive Principles of State Policy

The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

Unit-III

Union Government and its Administration Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

Unit-IV

Union Legislature and Judiciary

Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

Unit-V

Local Self Governments

Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

Textbooks:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Academy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, reprinted in 2022.

Suggested Reading:

1. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

22ADC32N

EXPLORATORY DATA ANALYSIS AND VISUALIZATION LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Python Programming

Course Objectives:

The course is designed to enable students to:

1. Develop foundational skills in performing numerical operations and array manipulations using NumPy.
2. Understand and apply data handling, transformation, and preprocessing techniques using Pandas.
3. Analyze structured datasets to identify trends, summarize information, and prepare data for analysis.
4. Create effective and customized data visualizations using Matplotlib and Seaborn to communicate insights.
5. Integrate EDA techniques in a real-world case study to perform a comprehensive analysis from data loading to visualization.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Apply NumPy functionalities such as array creation, indexing, broadcasting, and matrix operations for efficient data computation.
2. Utilize Pandas for creating, cleaning, transforming, and analysing structured data.
3. Perform complex data operations like merging, hierarchical indexing, grouping, and time series analysis using Pandas.
4. Generate various types of data visualizations using Matplotlib and Seaborn to reveal patterns and insights.
5. Execute an end-to-end exploratory data analysis on a domain-specific dataset, integrating all learned skills in a structured workflow.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	2	2	-	-	-	-	-	-	2	2	3
CO2	3	1	-	2	2	-	-	-	-	-	-	2	2	3
CO3	3	2	-	2	2	-	-	-	-	-	-	2	2	3
CO4	2	1	1	2	2	-	-	-	1	-	-	1	1	2
CO5	3	3	2	3	3	-	-	-	2	-	3	3	3	3

LIST OF PROGRAMS:

1. **NumPy Fundamentals:** Array creation: 1D, 2D, 3D arrays, Indexing, slicing, broadcasting, Arithmetic operations and matrix computations
2. **Advanced NumPy Operations:** Transposition and reshaping arrays, Random number generation, Aggregate functions and axis operations
3. **Pandas:** Series and Data Frame creation, Data Frame indexing, slicing, and selection, Basic operations and attributes
4. **Data Cleaning and Preprocessing:** Handling missing data (dropna, fillna), Replacing values and data type conversion, Detecting and removing duplicates

5. **Data Transformation and Categorization:** Mapping and renaming values, Binnand categorization, Sorting, ranking, and filtering data
6. **Hierarchical Indexing and Merging:** Multi-level indexing, Concatenating and merging DataFrames, reshaping with stack, unstack, and pivot
7. **GroupBy and Time Series Analysis:** Grouping and aggregation, Time series conversion and indexing, Resampling, frequency conversion, and date-based selection
8. **Data Visualization with Matplotlib and Seaborn**: Line plots, bar charts, histograms, scatter plots, Customizing plots (labels, legends, styles)
9. **Advanced Visualizations with Seaborn:** Categorical plots (box, violin), Heatmaps and pairplots, Styling themes and color palettes
10. **Case Study: End-to-End EDA**
    - Dataset: Choose from domains like healthcare, e-commerce, finance, or social media etc.
    - Data loading and preprocessing, Cleaning and wrangling, Grouping and time series (if applicable), Data visualization and insights
    - Deliverables: Jupyter notebook/ Colab notebool

TEXT BOOKS:

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", 3rd Edition, 2022

SUGGESTED READING:

2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.

WEB RESOURCES:

1. https://numpy.org/doc/stable/user/index.html
2. https://pandas.pydata.org/
3. https://matplotlib.org/
4. https://seaborn.pydata.org/tutorial.html
5. https://www.coursera.org/learn/data-analysis-with-python

DATASETS:

1. https://www.kaggle.com/datasets?search=Exploratory+data+analysis
2. https://archive.ics.uci.edu/

22ITC03N

JAVA PROGRAMMING LAB

(Common to CSE, IT, AI&DS, CET and allied branches)

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. Introduce the core principles of Object-Oriented Programming (OOP).
2. Explain the object-oriented approach to designing and implementing classes and objects.
3. Demonstrate the use of inheritance and polymorphism in Java.
4. Illustrate exception handling and multithreading techniques for managing runtime behavior.
5. Explore Java's IO package for developing basic input/output functionalities in applications.

Course Outcomes:

Upon successful completion of this course, student will be able to:

1. Apply OOP principles to design and develop Java applications.
2. Implement inheritance and interfaces to build modular and reusable code.
3. Use exception handling and multithreading to manage multiple execution paths efficiently.
4. Develop robust applications utilizing the Java Collection Framework.
5. Integrate Java IO concepts for effective data input and output operations in applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	2	2	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2
CO5	3	3	3	2	3	1	-	1	2	2	2	2	3	3

LIST OF EXPERIMENTS

1. Implement the program(s) to handle the various data types, operators, expressions, control-flow, and strings.
2. Develop a java program(s) for constructors.
3. Develop a java program to demonstrate the method overloading and riding.
4. Develop a java program(s) to deal with different types of inheritances and interfaces.
5. Implement the program(s) to demonstrate the packages.
6. Develop a java program(s) to handle user defined exceptions with multiple catch blocks.
7. Implement program(s) to demonstrate Multithreading and thread synchronization.
8. Implement program(s) to demonstrate generics.
9. Implement the collection framework classes with Iterator/List Iterator.

10. Develop a java program(s) to implement the features of JDK8.

Textbooks:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.

Suggested Reading:

1. E Balaguruswamy "Programming with Java", Tata McGraw-Hill, 6th Edition, 2019.
2. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition. 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22ADC33N

COMPETITIVE PROGRAMMING

Instruction	2P Hours per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1

COURSE OBJECTIVES:

1. Introduce the fundamentals of competitive programming and online coding platforms.
2. Equip students with skills for efficient input/output operations and core programming constructs.
3. Provide a strong foundation in data structures and algorithmic problem-solving techniques.
4. Enable application of advanced algorithms such as divide and conquer, backtracking, dynamic Programming, and greedy methods.
5. Develop the ability to solve real-time programming challenges using optimal and efficient code.

COURSE OUTCOMES:

After completion of the course, students will be able to:

1. Identify suitable algorithms and data structures for solving computational problems.
2. Apply basic and advanced problem-solving strategies in programming.
3. Develop code using programming best practices to enhance readability, efficiency, and performance.
4. Analyze different algorithmic techniques like divide and conquer, dynamic programming, and greedy methods.
5. Solve real-world problems by writing optimized and error-free code.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	-	1	-	-	-	-	-	-	2	2	2
CO2	3	3	3	-	1	-	-	-	-	-	-	2	2	2
CO3	2	3	2	-	1	-	-	-	-	-	-	2	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	-	1	-	-	-	-	-	-	2	2	2

PRE-REQUISITES/CO-REQUISITES:

Problem Solving and Programming, Problem Solving and Programming Lab, Data Structures, Data Structures Lab, Design and Analysis of Algorithms.

Week 1: Introduction and Basics

- Overview of Competitive Programming
- Setting up IDEs (Code Chef, Hacker Rank, LeetCode, etc.)
- Input/Output optimization (Fast I/O in C++/Python/Java)
- Basic Syntax, Loops, and Conditionals

Week 2: Searching and sorting

- Introduction to searching and sorting.
- Practice problems on sorting
- Practice problem on Searching algorithms

Week 3: Data Structures (Linear)

- Introduction to Linked List, Stack and Queues.
- Practice problems on applications of Linked List, Stack and Queues.

Week 4: Data Structures (Non - Linear)

- Introduction to Trees and Graphs.
- Practice problems on applications of Trees and Graphs.

Week 5: Advanced Data Structures

- Heaps and priority queues
- Hashing

Week 6: Bit Manipulation

- Practicing problem on Bit Manipulation

Week 7: Divide and conquer

- Introduction to Divide and Conquer Algorithms
- Practice Problems on Divide and Conquer

Week 8: Backtracking

- Introduction to Backtracking
- Practice problems on Backtracking

Week 9: Dynamic Programming

- Introduction to Dynamic Programming
- Practice Problem on Dynamic Programming

Week 10: Greedy Algorithms

- Introduction to Greedy Algorithms
- Practice Problems on Greedy Algorithms

PRACTICE PLATFORMS:

Regularly practice problems on online coding platforms like Code forces, Hacker Rank, Code Chef, and LeetCode.

TEXT BOOKS:

1. "Competitive Programming" by Steven Halim and Felix Halim
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
3. Leetcode 50 Common Interview Questions – Leetcode Clean Code Handbook, 2014

WEB RESOURCES:

1. https://www.topcoder.com/
2. https://www.geeksforgeeks.org/data-structures/?ref=shm
3. https://takeuforward.org/interviews/strivers-sde-sheet-top-coding-interview-problems/
4. https://www.geeksforgeeks.org/dsa-sheet-by-love-babbar/
5. https://neetcode.io/practice
6. https://docs.google.com/spreadsheets/d/1MGVBJ8HkRbCnU6EQASjJKCqQE8BWng4qgL0n3vCVOxE/ed it#gid=0
7. https://docs.google.com/spreadsheets/d/1kyHfGGaLTzWspcqMUUS5Httmip7t8LJB0P-uPrRLGos/edit#gid=0

NOTE: Incorporate Standard Template Library (STL) in C++, Java Collections Framework (JCF) in Java, and Python's built-in data structures like list, set, dict, tuple, along with modules such as heapq, collections, and itertools for efficient problem-solving and implementation.

22ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
SEE	--
CIE	50 Marks
Credits	2

Course Objectives:

This course aims to:

1. Exposing the students to the industrial environment and technologies
2. Provide possible opportunities to learn, make them understand and sharpen them to the real time technical/ managerial skills required at the job
3. Expose with the current technological developments relevant to program domain
4. Understand Engineer's responsibilities and ethics and provide opportunity to interact with the people of industry/society to understand the real conditions.

Course Outcomes:

After the completion of this course, the student will be able to:

1. Learn new technologies and apply them to solve real-time projects.
2. Address and analyze problems in industrial environments using relevant technologies.
3. Acquire in-depth knowledge of contemporary technologies and meet industrial requirements.
4. Identify, design, and develop innovative solutions for real-world problems.
5. Communicate their ideas and learning experiences through detailed reports and presentations.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	3	2	3	3	2	3
CO2	2	2	2	1	1	2	2	1	3	2	3	3	2	3
CO3	3	2	1	1	1	2	2	1	2	2	3	3	2	2
CO4	2	3	3	3	1	2	1	-	3	3	3	3	2	3
CO5	1	1	1	1	1	1	-	-	2	3	3	2	2	3

Process to Be Followed for Carrying Out Instructions to Students:

1. Students may apply for internships through the AICTE Portal or through CDC of the institute by filling in the application form IAP-101.
2. Industry shall scrutinize the students based on their criteria and communicate a provisional offer or confirmation letter to the student.
3. If students apply through CDC, then CDC shall nominate the students for various opportunities accordingly by issuing NOC (IAP-104).
4. The respective head of the department shall assign a faculty mentor.
5. Student shall undergo internship/industrial training at the concerned Industry/Organization by submitting the form, IAP-103.
6. During the internship, Faculty Mentor will evaluate the performance of students twice either by visiting the Industry/Organization or through obtaining periodic reports from students.
7. Student shall submit internship report to the industry/organization at the end of internship program.

8. On successful completion of the Internship, Industry/Organization shall issue Internship Certificate to the students
9. All the students should maintain discipline, professional ethics and follow the health and safety precautions during internship
10. Students should get approval for MOOCS and Training Programs and same evaluation process will be followed.

Student shall maintain diary during the internship and submit the internship report at the end of the internship. The report will be evaluated by the supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

Evaluation of Internship: The internship of the students will be evaluated in three stages:

a. Evaluation by the Industry (in the scale of 1 to **10** where 1-Unsatisfactory; 10-Excellent)
b. Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (**15** marks)
c. Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (**25 marks**)

For further details regarding templates, assessment guidelines please refer to the document from page number 16 onwards available at: https://www.cbit.ac.in/wp-content/uploads/2019/04/R22-Rules-with-internship-guidelines-10-11-2022..pdf

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
		THEORY						
1.	22MTC16	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2.	22ITC08N	Enterprise Application Development	3	-	3	40	60	3
3.	22ADC41N	Fundamentals of Machine Learning	3	-	3	40	60	3
4.		Professional Elective – I	3	-	3	40	60	3
5.	22CSC11N	Data Base Management Systems	3	-	3	40	60	3
6.	22MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
7.	22CEM01	Environmental Science	2	-	2	-	50	Non-Credit
		PRACTICAL						
8.	22ITC09N	Enterprise Application Development lab	-	3	3	50	50	1.5
9.	22CSC13N	Database Management Systems Lab	-	3	3	50	50	1.5
10.	22ADC42N	Fundamentals of Machine Learning Lab	-	3	3	50	50	1.5
12.	22ADU01	Upskill Certification Course-I	60 Hours			-	-	0.5
TOTAL			**20**	**9**		**410**	**560**	**23**
Clock Hours per week: 29								

L: Lecture **D: Drawing** **CIE – Continuous Internal Evaluation**
T: Tutorial **P: Practical** **SEE - Semester End Examination**

Professional Elective #1	Digital Image Processing (22ADE43N)	Modern Mobile Application Development (22ITE04N)	Formal Language Theory and Compiler Design (22ADE44N)	Data Warehousing (22ADE45N)	Principles of Programming Languages (22ADE46N)

22MTC16

STOCHASTIC PROCESS AND QUEUEING THEORY
(For AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Able to learn methods to solve bivariate probability functions.
2. Able to know characterizing the random process.
3. Able to identify the tools for interpretating the random process.
4. Able to know the statistical techniques for random process.
5. Able to analyses the queuing models.

Course Outcomes: On successful completion of this course the students shall be able to

1. Estimate the marginal probabilities of statistical averages.
2. Distinguish the random process of auto correlation and cross correlation.
3. Characterize the random process of ensemble averages.
4. Analyze the effect the thermal noise in the system.
5. Analyze the queuing behavior of different queuing models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO2	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO3	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO4	3	2	3	1	-	-	-	-	-	-	2	2	3	2
CO5	3	2	3	1	-	-	-	-	-	-	2	2	3	2

UNIT-I: Two-Dimensional Random Variables

Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two-dimensional random variable.

UNIT-II: Random Processes

Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Process, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t), Cross-Correlation Function and its Properties wide sense stationary process.

UNIT-III: Discrete Time Process

Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.

UNIT-IV: Applications of Random Process

Definition of Gaussian process, Properties, Band Pass Process, Narrow-Band Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markov process, Definition of a Markov chain and Transition Probabilities

UNIT-V: Queuing Theory

Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem-Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models-Measures of the (M/M/1):$(\infty/FIFO)$ $model$-Characteristic of Finite Capacity, Single Server Poisson Queue Model III (M/M/1):$(N/FCFS)$ Model.

Text Books

1. "Probability Statistics and Random Processes" by T Veerarajan,2nd Edition Tata McGraw-Hill.
2. "Fundamentals of Mathematical Statistics" by V.K.Kapoor & S.C.Gupta 11th revised Edition Sultan Chand & Sons.

Reference Books:

1. "Stochastic Process and Queueing Theory" by Randolph Nelson 1995,Ist edition, Springer- verlag Newyork.

Online Resources:

Course Code	Course Name	Resource Link
22MTC16	Stochastic Process and Queueing Theory	https://nptel.ac.in/courses/111102111

22ITC08N

ENTERPRISE APPLICATION DEVELOPMENT

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to:

1. Provide knowledge about web pages design and development.
2. Understand how the HTML, CSS and JavaScript components of Bootstrap work.
3. Explore the basic architecture of a React application and develop applications in agile mode.
4. Gain the basics of frond-end and back-end application development using Nodejs.
5. Understand the basics of MongoDB and its Data Model.
6.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Create web pages with good aesthetic sense of design using HTML and CSS.
2. Create real-world React web applications and related tools.
3. Become an agile practitioner with the ability to quickly complete projects.
4. Build an end-to-end application from scratch using NODE JS.
5. Understand and build logical relationships between documents using MongoDB.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	0	0	0	0	0	0	0	0	0	3
CO2	2	2	3	3	3	2	2	0	1	0	2	3	0	3
CO3	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO4	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO5	2	2	2	3	3	0	0	0	0	0	1	2	0	3

UNIT-I

Introduction to full stack: MVC pattern**,** Web Fundamentals. **HTML 5.0:** Basic tags, HTML DOM**,** Images, Tables, Lists, Forms, Layout, Graphics, span and div tags.

Introduction to Cascading Style Sheets: Types of CSS**,** CSS Selectors, CSS BOX Model, Text and Font, Color, CSS Positioning and CSS floating, CSS Grid layout Module, CSS Media Queries.

UNIT-II

Java Script: Data Types & Type Conversion, JSON, Events, String and Date Functions, Local Storage, Object Oriented Programming (OOP) in JS, JavaScript Regular Expressions.

Bootstrap: Introduction of Bootstrap, Container and Container-fluid, Bootstrap Carousel.

Bootstrap Component: Button, Grid, Table, Form, Alert, Image, Tabs/Pill, Navbar, Modals.

UNIT-III

React JS: Introduction to React, react with JSX, Actual DOM vs React VDOM, Components, Lifecycle, State, Props, Fragments, Events, Router, Forms, Pagination, Tables, Portals, Hook, Signals. React 18 New features.

Redux and MUI: Introduction to Redux, State, Actions, Reducers, Colour Reducer, Sort Reducer, Store, Action Creators, Middleware. React Material UI Introduction and Installation, MUI Input Components.

Integration of Google MAP API and GPS Location Tracking: Incorporating Google MAP API and GPS Location Tracking for location-based services.

UNIT-IV

Node JS: Modules, Node Package Manager(npm), Creating Web Server, Sending Requests and Handling HTTP requests, Handling User authentication with NodeJS, File System, Writing a file asynchronously and Other I/O Operations.

Events: Event Emitter class, Inheriting Events and Returning event emitter.

Express JS: Introduction to the Express framework- Server-side rendering with Templating Engines, Routing, Middleware, Custom Middleware, static files.

UNIT-V

Mongo DB: Introduction, Importance of NoSQL databases, JSON Vs BSON, Data types and examples. CRUD Operations, Data Modelling & Schema Design, Indexing and Aggregation, MongoDB Replication and Shading.

TEXT BOOKS:

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", Second Edition, Apress Publications, 2019.
2. David How's, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014.

SUGGESTED READING:

1. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014.

WEB RESOURCES:

1 https://web.stanford.edu/class/cs142/index.html
2 https://nodejs.org/en/docs/
3 https://www.mongodb.com/
4 https://reactjs.org/
5 https://getbootstrap.com/docs/5.0/utilities/api/
6 https://edu.anarcho-copy.org/Programming%20Languages/Node/

22ADC41N

FUNDAMENTALS OF MACHINE LEARNING

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:
1. Impart knowledge on the basic concepts of machine learning.
2. Familiarize different machine learning techniques.
3. Learn various Classification and Regression algorithms.
4. Familiarize various Kernels, SVMs and Ensemble methods.
5. Facilitate Dimensionality Reduction and Clustering.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Explain the types of machine learning and handle the challenges of machine learning.
2. Construct Decision Trees, Measure performance of classifiers.
3. Apply Regression, Logistic Regression and gradient descent to solve problems.
4. Design solutions using Bayesian classifier, SVMs and Ensemble methods.
5. Perform Dimensionality reduction and clustering of data.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	-	2	-	-	-	-	-	-	1	2	2	3
CO2	1	1	1	1	-	-	-	-	-	-	1	2	3	3
CO3	2	2	1	2	1	-	-	-	-	1	1	2	3	3
CO4	2	2	1	2	1	-	-	-	-	1	1	2	3	3
CO5	2	2	1	2	1	-	-	-	-	1	1	2	3	3

UNIT - I

The Machine Learning Landscape: What Is Machine Learning, Why Use Machine Learning, Examples of Applications, **Types of Machine Learning Systems:** Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, **Main Challenges of Machine Learning:** Insufficient Quantity of Training Data, Non representative Training Data, Poor-Quality Data, Irrelevant Features, Overfitting the Training Data, Under fitting the Training Data, Stepping Back, **Testing and Validation:** Hyper parameters Tuning and Model Selection , Data Mismatch.

UNIT - II

Classification: Training a Classifier, **Performance Measures:** Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, the ROC Curve, Multiclass Classification. **Decision Trees:** Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? Regularization Hyper parameters, Regression, Instability.

UNIT - III

Support Vector Machines: Linear SVM Classification, Soft Margin Classification, **Nonlinear SVM Classification:** Polynomial Kernel, Similarity Features, Gaussian RBF Kernel, Computational Complexity, SVM Regression, **Under the Hood:** Decision Function and Predictions, Training Objective, Kernelized SVMs. **Bayes Classification:** Maximum Posteriori, Bayes Belief Networks.

UNIT - IV

Regression: Linear Regression: The Normal Equation, Computational Complexity, **Gradient Descent:** Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, **Regularized Linear Models:** Ridge Regression, Lasso Regression, Elastic Net, Early Stopping, **Logistic Regression:** Estimating Probabilities, Training and Cost Function, Decision Boundaries, Softmax Regression.

UNIT - V

Dimensionality Reduction: The Curse of Dimensionality, PCA, Randomized PCA, Incremental PCA, Kernel PCA, LLE. **Unsupervised Learning Techniques: Clustering:** K-Means, Limits of K-Means, Using Clustering for Image Segmentation, DBSCAN, Other Clustering Algorithms, Gaussian Mixtures. **Ensemble Learning and Random Forests:** Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting.

TEXT BOOKS:

1. Aurelian Geron, “Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow”- Concepts, Tools, and

Techniques to Build Intelligent Systems, 2nd edition, O’Reilly, 2019.

SUGGESTED READING:

1.Tom Mitchel, “Machine Learning”, Tata McGraW Hill, 2017.

2.Stephen Marshland, “Machine Learning: An Algorithmic Perspective”, CRC Press Taylor & Francis, 2nd Edition, 2015

WEB RESOURCES:

https://www.coursera.org/specializations/machine-learning

22CSC11N

DATA BASE MANAGEMENT SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Programming and Data Structures.

Course Objectives:

This course aims to:

1. Familiarize students with fundamental concepts of database management. These concepts include aspects of database design, database languages and database-system implementation.
2. Understand about data storage techniques and indexing.
3. Impart knowledge in transaction management, concurrency control techniques and recovery procedures.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand fundamental concepts of database and design database schema for an application.
2. Write relational algebra expression and SQL queries for various tasks.
3. Apply the principles of functional dependency and normalization to ensure data integrity
4. Understand indexing and transaction processing
5. Analyze transaction processing, concurrency control and recovery mechanisms.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	-	-	1	3	2	2
CO2	2	3	2	2	3	-	-	-	-	-	1	3	3	1
CO3	2	1	2	1	3	-	-	-	-	-	-	3	2	2
CO4	2	1	1	-	-	-	-	-	-	-	-	2	3	2
CO5	2	1	-	1	-	-	-	-	-	-	-	2	3	2

UNIT-I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators, Database System Architecture, Data Models, **E-R Model**: Introduction, Constraints, E-R Diagrams, E-R Design Issues, Mapping from ER to relational model, Extended E-R Features.

UNIT-II

Relational Algebra: Introduction to relational algebra operations, Basic relational algebra operators, Natural join, Assignment operator. **SQL:** Data Types, Basic Structure of SQL Queries, Modification of the Database, Set Operations, Aggregate Functions, Data-Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Sub queries, Views)

UNIT-III

Functional Dependency: Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Attribute closure, Irreducible Set of Functional Dependencies, lossless decomposition, **Normalization**–1NF,

2NF, 3NF and BCNF, Dependency preserved decomposition, Comparison of BCNF and 3NF.

UNIT–IV

Indexing: Basic Concepts, Primary Index, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+Tree Index Files, Hash indices, Bitmap indices. **Transaction Processing:** Concept of transactions and schedules, ACID properties, Conflict-serializability

UNIT-V

Concurrency control: Lock-Based Protocols, Dead lock handling, Timestamp-Based Protocols, Validation-Based Protocols. **Recovery system:** Failure classification, Log based recovery, recovery algorithm, ARIES.

Text Books:

1. Silberschatz, Korth and Sudarshan, “Database System Concepts”, 7th Edition, McGraw-Hill, 2021.
2. C.J. Date, "An Introduction to Database Systems", 8th edition, Pearson, 2020,

Suggested Reading:

1. Raghu Ramakrishna, Johnnes Gehrke, “Database Management Systems”, 3rd Edition, McGraw Hill, 2014.
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson Pubs, 2017.
3. Lemahieu, Broucke and Baesens, “Principles of Database Management”, Cambridge University Press, 2018.
4. Krishnan, “Database Management Systems”, McGraw Hill.

Online Resources:

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html.

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

COURSE OUTCOMES: After Completion of the Course, Student will be able to:

1. Apply fundamental knowledge of Managerial Economics Concepts and Tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make the best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	3	1	1	1	-	1	1	1	-	2	1	2
CO2	2	2	2	2	-	1	-	1	-	1	-	2	1	2
CO3	1	2	1	2	2	1	-	1	-	1	-	2	1	2
CO4	2	2	1	2	2	1	-	3	-	1	-	2	2	1
CO5	1	3	1	2	1	1	-	-	-	1	2	2	2	2

UNIT-I

Introduction to Managerial Economics

Introduction to Economics and Its Evolution - Managerial Economics - Its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic Concepts of Managerial Economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equi-Marginal Principle, Contribution, Negotiation Principle.

UNIT-II

Demand and Supply Analysis

Demand Analysis - Concept of Demand, Determinants, Law of Demand – Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple Numerical Problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III

Production and Cost Analysis

Theory of Production - Production function - Isoquants and Iso-costs, MRTS, Input - Output Relations; Laws of Returns. Cost Analysis: Cost Concepts – Types of Costs, Cost - Output Relationship – Short Run and Long Run; Market Structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition. Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV

Accountancy

Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger Accounts, Trial Balance Concept and preparation of Final Accounts with Simple Adjustments.

UNIT-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and Sources of raising Finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical Problems.

TEXT BOOKS:

1. Mehta P.L., "Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

SUGGESTED READINGS:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018

22CEM01

ENVIRONMENTAL SCIENCE

Instruction	2L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	0

Course Objectives: To enable the students to

1. Identify environmental problems arising due to engineering and technological activities and the Science behind those problems.
2. Become aware about the importance of eco system and biodiversity for maintaining ecological balance.
3. To identify the importance of interlinking of food chain.
4. Learn about various attributes of pollution management and waste management practices.
5. To make the students contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes: At the end of the course, student is able to

1. Identify various natural resources and effects of their over utilization.
2. Outline the working mechanism of ecosystem.
3. Illustrate the importance of bio-diversity conservation.
4. Identify remediation measures for environmental pollution through legislations.
5. Explain environmental issues and possible sustainable solutions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	2	-	-	-	1	-	-	-
CO2	3	1	-	-	-	1	1	-	-	-	1	-	-	-
CO3	3	1	-	-	-	2	2	-	-	-	1	-	-	-
CO4	3	1	-	-	-	2	2	2	-	-	1	-	-	-
CO5	3	1	-	-	-	2	3	-	-		1	-	-	-

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wildlife Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards.

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
2. https://archive.nptel.ac.in/courses/120/108/120108004/

22ADE43N

DIGITAL IMAGE PROCESSING

(Professional Elective #1)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: Matrices and Vectors

COURSE OBJECTIVES: This course aims to:

1. Understand the Fundamentals of Image Processing
2. Learn Image Enhancement Techniques
3. Study Color Image Processing
4. Understand Image Segmentation and Edge Detection.
5. Explore Image Compression Techniques

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Describe image formation, sensing techniques, and image representation formats used in imaging systems.
2. Apply spatial and transform domain filters for basic image analysis and processing.
3. Explain image enhancement techniques in both spatial and frequency domains.
4. Apply restoration techniques to reconstruct degraded images using noise and degradation models
5. Compare geometric restoration and image compression methods for efficient image representation.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO2	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO3	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO4	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO5	3	2	1	-	-	-	-	-	-	-	2	2	1	3

UNIT - I

Digital Image Processing and Analysis, Image Processing and Human Vision, Digital Imaging Systems, Digital Imaging Systems, Image Formation and Sensing, Visible Light Imaging, Imaging Outside the Visible Range of the EM Spectrum, Acoustic Imaging, Electron Imaging, Laser Imaging, Computer-Generated Images, Image Representation, Binary Images, Gray-Scale Images, Color Images, Multispectral and Multiband Images, Digital Image File Formats.

UNIT - II

Transform Filters, Spatial Filters and the Wavelet: Low pass Filters, High pass Filters, Bandpass, Band reject and Notch Filters, Spatial Filtering via Convolution, Lowpass Filtering in the Spatial Domain, High pass Filtering in the Spatial Domain, Bandpass and Band reject Filtering in the Spatial Domain, Discrete Wavelet Transform,

UNIT - III

Image Enhancement: Gray-Scale Modification, Mapping Equations, Histogram Modification, Adaptive

Contrast Enhancement, Color Image, Sharpening, High pass Filtering, High-Frequency Emphasis (HFE), Directional Difference Filters, Homomorphic Filtering, Unsharp Masking, Edge Detector–Based Sharpening Algorithms, Image Smoothing, Frequency Domain Smoothing, Spatial Domain Smoothing, Smoothing with Nonlinear Filters.

UNIT – IV

Image Restoration and Reconstruction: System Model, Noise Models, Noise Histograms, Periodic Noise, Estimation of Noise, Noise Removal Using Spatial Filters, Order Filters, Mean Filters, Adaptive Filters, The Degradation Function, The Spatial Domain – The Point Spread Function, The Frequency Domain – The Modulation/Optical Transfer Function, Estimation of the Degradation Function, Frequency Domain Restoration Filters, Inverse Filter, Wiener Filter, Constrained Least Squares Filter, Geometric Mean Filters Adaptive Filtering, Bandpass, Band reject and Notch Filters, Practical Considerations, Geometric Transforms,

UNIT - V

Spatial Transforms, Gray-Level Interpolation, The Geometric Restoration Procedure, Geometric Restoration with CVIPtools, Image Reconstruction, and Reconstruction Using Back projections, The Radon Transform, The Fourier-Slice Theorem and Direct Fourier Reconstruction. **Image Compression:** Compression System Model, Lossless Compression Methods, Huffman Coding, Golomb-Rice Coding, Run-Length Coding, Lempel–Ziv–Welch Coding, Arithmetic Coding, Lossy Compression Methods, Gray-Level Run-Length Coding, Block Truncation Coding, Vector Quantization, Differential Predictive Coding, Model-Based and Fractal Compression, Transform Coding, Hybrid and Wavelet Methods.

TEXT BOOK:

1. Scott E Umbaugh , Digital Image Processing and Analysis, Fourth Edition, Tayler and Frances, 2023

SUGGESTED READING:

1. Wilhelm Burger Mark J. Burge , Digital Image Processing An Algorithmic Introduction, Third edition, 2022
2. Guillermo Guillen, Sensor Projects with Raspberry Pi: Internet of Things and Digital Image Processing, Second Edition, 2024

Web Resources:

1. https://www.mathworks.com/solutions/image-video-processing/resources.html
2. https://archive.nptel.ac.in/courses/117/105/117105135/

22ITE04N

MODERN MOBILE APPLICATION DEVELOPMENT

(Professional Elective #1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Introduce Flutter and Dart programming for cross-platform mobile application development.
2. Enable the design, development, and deployment of interactive and data-driven mobile applications.
3. Explore advanced concepts such as state management, animations, API integration, and database connectivity.

Course Outcomes:

Upon completing this course, learners will be able to:

1. Develop mobile applications using Flutter widgets, layouts, and animations.
2. Apply state management techniques for efficient app performance.
3. Integrate APIs and databases for real-time data processing.
4. Utilize Dart packages to enhance app functionality and performance.
5. Deploy and optimize Flutter applications on Android and iOS platforms.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	-	-	1	1	1	1	2	3	1
CO2	3	3	3	2	3	-	-	1	1	1	1	2	3	1
CO3	3	3	3	2	3	-	-	1	1	-	-	3	3	2
CO4	3	3	3	3	3	-	-	1	1	1	1	2	3	2
CO5	3	3	3	3	3	-	-	1	1	1	1	2	3	2

UNIT I: Introduction to Flutter

Features of Flutter, Advantages of Flutter, Disadvantages of Flutter, Architecture of Flutter Applications, Core Principles of Flutter Development, and Comparison with Other Cross-Platform Frameworks, Real-World Applications of Flutter, and Flutter's Role in Modern UI/UX Design

UNIT II: Flutter Basics & Dart Programming

Widgets, Gestures, Introduction to Dart Programming, Variables and Data Types, Decision Making and Loops, Functions, Object-Oriented Programming, Introduction to Widgets, Widget Build Visualization, Basic Programming, OOP Concepts, Exception Handling, Debugging, Asynchronous Programming – Futures, Async, Await, Streams.

UNIT III: UI Development & Layouts

Types of Layout Widgets, Single Child Widgets, Multiple Child Widgets, Advanced Layout Application, Introduction to Gestures, State Management in Flutter, Ephemeral State Management, Application State, Scoped Model, Navigation and Routing, Styles and Assets, Fonts, Model API, Media Query.

UNIT IV: Animations & API Integration
Introduction to Animation-Based Classes, Workflow of Flutter Animation, Working Application, Android-Specific Code on Flutter, Introduction to Packages, Types of Packages, Using a Dart Package, Developing a Flutter Plugin Package, Accessing REST API, Basic Concepts, Accessing Product Service API.

UNIT V: Database & Deployment
SQLite, Cloud Fire store, Internationalization on Flutter, Using intl Package, Testing on Flutter, Types of Testing, Widget Testing, Steps Involved, Working Example, Deployment, Android Application, iOS Application, Development Tools, Widget Sets, Flutter Development with Visual Studio Code, Dart DevTools, Flutter SDK.

Textbook:

1. Marco L. Napoli, Beginning Flutter: A Hands-On Guide to App Development, Apress, 2019.

Suggested Reading:

1. Alessandro Biessek, “Flutter for Beginners: An Introductory Guide to App Development”, Packet Publishing, 2020.
2. Rap Payne, “Flutter & Dart: The Complete Guide to Build Cross-Platform Apps”, 2019.
3. David Griffiths & Dawn Griffiths, “Head First Android Development”, O'Reilly Media, 2017.

Web Resources:

1. Flutter Official Documentation – https://flutter.dev/docs
2. Dart Language Guide – https://dart.dev/guides
3. Google Codelabs (Flutter Tutorials) – https://codelabs.developers.google.com/?cat=Flutter
4. Flutter & Dart API Reference – https://api.flutter.dev

22ADE44N

FORMAL LANGUAGE THEORY AND COMPILER DESIGN

(Professional Elective #1)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: NIL

Course Objectives:

1. Understand the foundational concepts of formal languages, finite automata, and Chomsky hierarchy
2. Explore regular languages, context-free grammars, and their representation using various normal forms.
3. Analyze and construct Pushdown Automata and Turing Machines for the recognition of context- free and recursively enumerable languages.
4. Apply the phases of compiler design, especially lexical and syntax analysis techniques using tools like LEX and YACC.
5. Develop syntax-directed definitions and generate intermediate code using translation schemes and intermediate representations.

Course Outcomes: At the end of the Course the student shall be able to

1. Explain the concepts of formal languages, automata theory, and Chomsky hierarchy. (BL2)
2. Analyze and apply regular expressions and finite automata for language recognition (BL3)
3. Construct PDA and Turing machines for the given set of languages (BL3)
4. Build the lexical and Syntax analyzer phases of compiler (BL3)
5. Model SDD's using Intermediate Representations (BL3)

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	3	3
CO2	1	1	-	-	2	-	-	-	-	-	-	1	3	3
CO3	-	1	1	1	1	-	-	-	-	-	-	-	3	3
CO4	-	1	1	-	1	2	-	1	-	-	-	1	3	3
CO5	-	1	-	1	1	1	-	1	-	-	-	1	3	3

UNIT-I

Fundamentals: Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore

UNIT-II

Regular Languages: Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets (proofs not required). Context Free Grammars: Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion

and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form, Greibach normal form, Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.

UNIT-III

Pushdown Automata: Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of context free grammars and pushdown automata, Inter-conversion (Proofs not required). Turing Machine: Introduction to Turing Machine, Design of Turing machines, Types of Turing machines

UNIT-IV

Introduction To Compiling: Overview of Compilers, Phases of a Compiler. Lexical Analysis: The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A language for specifying Lexical Analyzers(LEX). Syntax Analysis: The role of the Parser, First and Follow, Predictive Parsing, LR Parsers-SLR, Canonical LR, LALR, Parser Generator(YACC).

UNIT-V

Syntax-Directed Translation: Syntax-Directed Definition, S-Attributed SDD, L-Attributed SDD, Translation Schemes. Intermediate Code Generation: Intermediate Languages- Graphical Representations, Three address code, Implementations.

TEXT BOOKS:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Compilers: Principles, Techniques & Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman,2nd Edition, Pearson.

SUGGESTED READING:

1. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
2. Kenneth C Louden, Thomson, “Compiler Construction Principles and Practice”, PWS Publishing 1st edition.

NPTEL RESOURCES:

1. Theory of Automata and Formal Languages, IIT Guwahati https://nptel.ac.in/courses/106103070
2. Theory of Automata, Formal Languages and Computation, IIT Madras https://nptel.ac.in/courses/106106049
3. Formal Languages and Automata Theory, IIT Guwahati https://nptel.ac.in/courses/111103016
4. NOC: Introduction to Automata, Languages and Computation, IIT Kharagpur https://nptel.ac.in/courses/106105196
5. Principles of Compiler Design, IISc Bangalore https://nptel.ac.in/courses/106108113
6. Compiler Design, IISc Bangalore https://nptel.ac.in/courses/106108052

22ADE45N

DATA WAREHOUSING

(Professional Elective #1)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: NIL

Course Objectives:

1. To understand the fundamental concepts, architecture, and need for Data Warehousing in modern business environments.
2. To impart knowledge on planning, gathering requirements, and designing a robust Data Warehouse system.
3. To equip students with dimensional modelling techniques using star and snowflake schemas.
4. To explore the ETL process and strategies for maintaining high data quality.
5. To introduce OLAP systems, operations, and implementation practices for effective information delivery.

Course Outcomes: At the end of the Course the student shall be able to

1. Explain the basic concepts, architecture, and evolution of data warehousing systems. (BL2)
2. Design dimensional models using star, snowflake schemas, and define fact/dimension tables.
3. Demonstrate understanding of the ETL process and techniques to ensure data quality and integrity. (BL3)
4. Apply OLAP operations and evaluate data delivery mechanisms for strategic decision-making. (BL3)
5. Evaluate the implementation, deployment, and maintenance strategies of a data warehouse, and identify emerging trends and technologies in modern data warehousing. (BL3)

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	-	-	-	-	-	-	-	2	2	2	3
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2	3
CO3	1	1	-	2	2	-	-	-	-	-	-	3	1	3
CO4	-	1	1	-	2	2	-	-	2	-	-	2	2	3
CO5	-	-	-	-	2	-	-	-	-	3	3	2	2	3

UNIT-I

Data warehouse: Introduction to Data warehouse, Difference between operational database systems and data warehouses, Data warehouse Characteristics, Data warehouse Architecture and its Components, Data Marts: Dependent vs Independent, Role of Metadata in Data Warehousing, Data Warehousing Process Overview, Challenges in Data Warehousing.

UNIT-II

Data Warehouse Design and Modeling: Dimensional modeling, Star schema, Snowflake schema, and Fact constellation, Fact and dimension tables, Measures: additive, semi-additive, and non-additive, slowly Changing Dimensions (SCDs), Granularity in fact tables.

UNIT-III

ETL Process and Data Quality: ETL tools and their architecture, Data extraction methods, Data cleaning and transformation techniques, Handling missing values and duplicates, Data integration issues, Data profiling and quality management

UNIT-IV

Data warehouse OLAP: Information Delivery, Information Delivery tools, Data Warehouse and OLAP, Major Features and Functions, OLAP Models, OLAP Implementation Considerations.

UNIT-V

Data Warehouse Deployment and Future Trends: Data Warehouse Implementation Phases, Deployment and Roll-out Strategies, Performance Tuning and Optimization, Maintenance and Growth of the Data Warehouse, Future Trends in Data Warehousing: Real-time Data Warehousing, Data Warehousing in the Cloud, Integration with Big Data and NoSQL, Self-service BI and Visualization Tools.

TEXT BOOKS:

1. Data Warehousing Fundamentals for IT Professionals 2e by Paulraj Ponniah, Wiley-Interscience
2. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Ralph Kimball and Margy Ross, Wiley

SUGGESTED READING:

1. Data Warehousing, Data Mining, and OLAP, Alex Berson and Stephen J. Smith, McGraw-Hill.
2. Building the Data Warehouse, W.H. Inmon, Wiley.

WEB RESOURCES:

1. https://www.coursera.org/specializations/data-warehousing
2. https://www.nptelvideos.com/lecture.php?id=5934
3. https://www.coursera.org/learn/data-warehousing

22ADE46N

PRINCIPLES OF PROGRAMMING LANGUAGES

(Professional Elective #1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Objectives:

1. To provide a concise overview of different programming paradigms.
2. To develop a conceptual understanding of the design and implementation of high-level programming languages.
3. To explore the capabilities and advantages of scripting languages.

Outcomes:

1. Describe different programming paradigms, language categories, and syntax description techniques using formal methods like BNF and parse trees.
2. *Analyze* the design and implementation issues of data types, variable bindings, and control structures in high-level programming languages.
3. Compare various subprogram design strategies including parameter passing, scoping, and overloading in procedural languages.
4. Evaluate abstraction mechanisms, concurrency constructs, and exception handling techniques across multiple programming paradigms including logic programming.
5. Differentiate between functional and imperative languages and demonstrate scripting language features using Python.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	1	1	-	2	1	1
CO2	3	3	3	2	3	-	-	-	1	1	-	2	1	1
CO3	3	3	3	2	2	-	-	-	1	-	-	2	2	1
CO4	3	3	3	3	3	-	-	1	1	1	1	2	1	1
CO5	3	3	3	3	3	-	-	-	1	1	1	2	2	1

UNIT I:

Preliminary Concepts: Reasons for studying, concepts of programming languages, Programming domains, Language Evaluation Criteria, influences on Language design, Language categories, Programming Paradigms – Imperative, Object Oriented, functional Programming , Logic Programming. Programming Language Implementation – Compilation and Virtual Machines, programming environments. **Syntax and Semantics:** general Problem of describing Syntax and Semantics, formal methods of describing syntax - BNF, EBNF for common programming languages features, parse trees, ambiguous grammars, attribute grammars, denotational semantics and axiomatic semantics for common programming language features.

UNIT II:

Data types: Introduction, primitive, character, user defined, array, associative, record, union, pointer and reference types, design and implementation uses related to these types. Names, Variable, concept of binding, type checking, strong typing, type compatibility, named constants, variable initialization. **Expressions and Statements:** Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures – Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, and guarded commands.

UNIT III :

Subprograms and Blocks: Fundamentals of sub-programs, Scope of life time of varaibles, static and dynamic scope, design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

UNIT IV :

Abstract Data types: Abstractions and encapsulation, introductions to data abstraction, design issues, language examples, C++ parameterized ADT, object oriented programming in small talk, C++, Java, C#, Ada 95

Concurrency: Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads.

Exception handling: Exceptions, exception Propagation, Exception handler in Ada, C++ and Java.

Logic Programming Language: Introduction and overview of logic programming, basic elements of prolog, application of logic programming.

UNIT V:

Functional Programming Languages: Introduction, fundamentals of FPL, LISP, ML, Haskell, application of Functional Programming Languages and comparison of functional and imperative Languages.

Scripting Language: Pragmatics, Key Concepts, Case Study: Python- Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Separate Compilation, Module Library.

TEXT BOOKS:

1. Concepts of Programming Languages Robert .W. Sebesta 8/e, Pearson Education, 2008.
2. Programming Language Design Concepts, D. A. Watt, Wiley dreamtech, rp-2007.

REFERENCE BOOKS:

1. Programming Languages, 2nd Edition, A. B. Tucker, R. E. Noonan, TMH.
2. Programming Languages, K. C. Louden, 2nd Edition, Thomson, 2003.
3. LISP Patric Henry Winston and Paul Horn Pearson Education.
4. Programming in Prolog, W. F. Clocksin & C. S. Mellish, 5th Edition, Springer.
5. Programming Python, M. Lutz, 3rd Edition, O'reilly, SPD, rp-2007.

6. Core Python Programming, Chun, II Edition, Pearson Education, 2007.
7. Guide to Programming with Python, Michel Dawson, Thomson, 2008

22ITC09N

ENTERPRISE APPLICATION DEVELOPMENT LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES

This course aims to:

1. Understand and practice HTML5 and CSS.
2. Introduce the fundamental concepts of JavaScript and Bootstrap.
3. Understand the concepts of Client-side JS Framework.
4. Work with the concepts of Server-side JS Framework.
5. Be familiar with real time database.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Apply HTML and CSS effectively to create dynamic websites.
2. Describe and utilize JavaScript concepts in real-world applications.
3. Develop single page applications in React Framework.
4. Use Node.js for server-side application development.
5. Design the Realtime database applications based on the requirements.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	0	2	0	1	0	2	3	0	3
CO2	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO3	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO4	2	3	3	3	3	2	2	0	1	0	2	3	0	3
CO5	2	3	2	3	3	0	2	0	1	0	2	3	0	3

LIST OF EXPERIMENTS:

1. Design a Login Page using HTML, CSS (Media Query) and JavaScript.
2. Design a chessboard pattern using HTML and CSS.
3. Design a calculator application using JavaScript.
4. Create responsive web page of your class time table by using bootstrap grid system.
5. Create a timer component to start, pause and reset using ReactJS.
6. Create a React component that checks the strength of a password and displays the result to the user. The component will take user input and use a set of rules to determine the strength of the password.
7. Design the authorized end points using JWT (JSON Web Token)
8. Develop a backend application with REST API to perform CRUD operations on student data. (Use Postman Tool)
9. Design replica set of student database and insert records in primary node and display the records in secondary nodes.
10. Create Real-Time Chat Features in a Web Application Using React, Node.js, Socket.io, and MongoDB.

TEXT BOOKS:

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", second Edition, Apress Publications, 2019.
2. David Hows, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014.

SUGGESTED READING:

1. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014.

WEB RESOURCES:

1. https://web.stanford.edu/class/cs142/index.html
2. https://nodejs.org/en/docs/
3. https://www.mongodb.com/
4. https://reactjs.org/
5. https://getbootstrap.com/docs/5.0/utilities/api/
6. https://edu.anarcho-copy.org/Programming%20Languages/Node/

22CSC13N

DATABASE MANAGEMENT SYSTEMS LAB

Instruction	3 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. Become familiar with the concepts of structured query language.
2. Understand about Programming Language / Structured Query Language (PL/SQL).
3. Learn database constraints, DCL, TCL and advanced SQL commands.
4. Familiarize with cursors, triggers, exceptions, procedures and functions in PL/SQL.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Outline the built-in functions of SQL and Create, Alter and Drop table.
2. Demonstrate Queries to retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, save point commands and formulate the Queries for Creating Views and constraints.
4. Develop queries using Joins, Sub-Queries.
5. Develop PL/SQL code to create stored procedures, functions, cursors and exceptions.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	1	2	3	1
CO 2	3	2	2	2	3	-	-	-	-	-	1	2	3	1
CO 3	3	1	2	1	3	-	-	-	-	-	-	2	3	2
CO 4	3	-		2	-	-	-	-	-	-	-	2	3	2
CO 5	3	1	2	1	-	-	-	-	-	-	-	3	3	2

List of Experiments:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using DDL and DML statements.
3. Queries using Group By, Order By, Having Clauses and set operations.
4. Queries on Controlling Data: Commit, Rollback and Save point.
5. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
6. Queries using Joins, views and Sub-Queries.
7. Write PL/SQL code using Basic Variables, bind and substitution variables.
8. Write PL/SQL code using Control Structures.
9. Write PL/SQL code using Procedures, Functions.
10. Write PL/SQL code using Cursors, Triggers and Exceptions.

Text Books:

1. "Oracle: The complete Reference", Oracle Press.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.

Suggested Reading:

1. Rick FVander Lans, "Introduction to SQL", 4th Edition, Pearson Education, 2007.
2. "The Language of SQL (Learning)" by Larry Rockoff.
3. Steven Feuerstein, "Oracle PL/SQL Programming", 6th Edition, O'reilly publications, 2014.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs91/preview

22ADC42N

FUNDAMENTALS OF MACHINE LEARNING LAB

Instruction	3 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives: This course aims to:

1. Impart knowledge of dimensionality reduction and clustering techniques.
2. Introduce the concept of decision tree for supervised learning.
3. Familiarize with Bayesian decision theory and probabilistic methods.
4. Introduce the concept of SVM.
5. Familiarize with ensemble methods.

Course Outcomes: After the completion of this course, the student will be able to

1. Perform dimensionality reduction of a dataset.
2. Build decision trees for classification.
3. Design solutions using SVM, KNN, Regression algorithms.
4. Perform clustering of data.
5. Use principle Component Analysis for feature Extraction.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	2	2	-	-	-	-	-	1	2	2	3
CO 2	3	2	1	1	-	-	-	-	-	-	2	1	1	3
CO 3	2	1	1	1	-	-	-	-	-	-	2	2	1	3
CO 4	2	2	1	1	-	-	-	-	-	-	2	1	1	3
CO 5	2	1	1	1	-	-	-	-	-	-	2	1	1	3

LIST OF PROGRAMS

1. Vectors, Matrices, and Arrays representation, loading of different types of data.
2. Data Wrangling, Handling Numerical, Categorical and Image Data.
3. Decision Trees and Support Vector Machines.
4. Implement Logistic Regression and K-Nearest Neighbor classifiers.
5. Random Forest and Naive Bayes classifier for continuous and discrete datasets.
6. Linear Regression, Nonlinear Regression, and Dependent Regression.
7. Ridge Regression and Lasso Regression.
8. Data Reduction using Feature Extraction, Feature Selection, PCA.
9. Clustering using K-Means, DBSCAN and Hierarchal Clustering.

10. Model Selection, Saving and Loading Trained Models.

TEXT BOOKS:

1. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, 2nd Edition, 2019.
2. Chris Albon, "Python Machine Learning Cook Book". Orielly, Ist Edition, 2018

SUGGESTED READING:

1. Tom Mitchel, "Machine Learning", Tata McGraW Hill, 2017.
2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", CRC Press Taylor & Francis, 2nd Edition, 2015

DATASETS:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

WEB RESOURCE:

1. https://www.coursera.org/specializations/machine-learning

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – V

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	22ADC51N	Advanced Artificial Neural Networks	3	-	3	40	60	3
2.	22ADC52N	Introduction to Data Science	3	-	3	40	60	3
3.	22CSC15N	Operating Systems	3	-	3	40	60	3
4.	22CSC21N	Software Engineering	3	-	3	40	60	3
5.	22ITC10N	Computer Networks	3	-	3	40	60	3
6.		Professional Elective – 2	3	-	3	40	60	3
PRACTICAL								
7.	22ADC53N	Advanced Artificial Neural Networks Lab	-	3	3	50	50	1.5
8.	22ADC54N	Introduction to Data Science Lab	-	3	3	50	50	1.5
9.	22ADC55N	Mini Project	-	2	-	50	-	1
8.	22ADI02	Industrial / Rural Internship	4-6 Weeks 135 Hours		-	50		2
TOTAL			**18**	**8**		**440**	**460**	**24**
		Clock Hours Per Week: 26						

L: Lecture **T: Tutorial** **CIE – Continuous Internal Evaluation**
D: Drawing **P: Practical** **SEE - Semester End Examination**

Professional Elective #2	Federated Machine Learning (22ADE56N)	Applied Predictive Analytics (22ADE57N)	Business Intelligence (22ADE58N)	Principles of Cryptography (22ADE59N)	Natural Language Processing with Transformers (22ADE50N)

22ADC51N

ADVANCED ARTIFICIAL NEURAL NETWORKS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Fundamentals of machine Learning, Python Programming

Course Objectives:

This course aims to:

1. Understand the fundamentals and history of deep learning and its differentiation from traditional machine learning.
2. Analyze the working principles of multilayer perceptron's, backpropagation, and activation functions.
3. Explore various optimization techniques and regularization methods to improve deep neural networks.
4. Design and apply Convolutional Neural Networks (CNNs) for image-based tasks.
5. Understand and implement sequence models like RNNs, LSTMs, and autoencoders for sequential and unsupervised tasks.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basic principles and evolution of deep learning and tools like TensorFlow/Keras.
2. Construct and train deep neural networks using backpropagation and various activation functions.
3. Evaluate the effectiveness of different optimization algorithms and regularization techniques.
4. Design and implement convolutional neural networks for image-related applications.
5. Apply sequence models and autoencoders for sequence modeling tasks.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	2	-	1	2	-	3	2	3
CO2	3	3	2	2	3	2	2	-	-	2	-	3	2	3
CO3	3	3	2	3	3	2	2	-	1	2	-	3	2	3
CO4	3	2	2	2	3	2	2	-	1	2	-	3	2	-
CO5	3	2	2	2	3	2	2	-	1	2	-	3	2	-

UNIT - I

Introduction to Deep Learning: What is Deep Learning, History and evolution of neural networks, Deep Learning vs. Machine Learning, Applications (Vision, NLP, Robotics, etc.), Tools: TensorFlow, PyTorch, Keras

UNIT- II

Deep Neural Networks Fundamentals: Perceptron, Sigmoid Neuron, Example: Learning XOR, MLP Architecture, Back propagation with gradient descent, Loss Functions, Output Units- Sigmoid, Softmax, Hidden Units- Activation functions- Sigmoid, Tanh, Rectified Linear Unit(Relu), Leaky Relu, Vanishing Gradient in MLP,

UNIT- III

Optimization Algorithms: Challenges in Neural Network Optimization, Stochastic Gradient Descent, Momentum, Nesterov Momentum **Algorithms with Adaptive Learning Rates**: AdaGrad, RMSProp, Adam, Choosing the Right Optimization Algorithm, **Overfitting:** Parameter Norm Penalties, L2 Parameter Regularization, L1 Regularization, Dataset Augmentation, Noise Robustness, Injecting Noise at the Output Targets, Early Stopping Parameter Tying and Parameter Sharing, Dropout, Batch Normalization, Parameter

Initialization Strategies, **Hyperparameter Tuning:** Manual Hyperparameter Tuning, Automatic Hyperparameter Optimization Algorithms

UNIT - IV

Convolution Neural Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structures outputs, Datatypes, Pretrained Models: Alex Net, VGG, Googlenet, Resnet, Visualization in CNN

UNIT- V

Sequence Models: Recurrent Neural Networks, Teacher Forcing and Networks with Output Recurrence, Computing the Gradient, Modeling Sequences Conditioned on Context, Bidirectional RNNs, Deep Recurrent Networks, The Challenge of Long-Term Dependencies, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Encoder-Decoder models with attention, **Autoencoder**: Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders, GAN Modelling

TEXTBOOKS:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press, 2016.
2. Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2020). *Dive into Deep Learning*

SUGGESTED BOOKS:

1. Chollet, F. (2021). *Deep learning with Python* (2nd ed.). Manning Publication
2. Nielsen, M. A. (2015). *Neural networks and deep learning:*

WEB RESOURCES:

1. http://neuralnetworksanddeeplearning.com/
2. https://paperswithcode.com/

22ADC52N

INTRODUCTION TO DATA SCIENCE

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To introduce Data Science with R.
2. To impart knowledge on the concepts of Exploring and Cleaning data.
3. To familiarize Supervised and Unsupervised Techniques.
4. To introduce documentation and deployment using R
5. To familiarize text mining with R.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand and explain the fundamentals of Data Science using R, including key concepts, methodologies, and applications.
2. Explore and clean datasets effectively, applying appropriate techniques to prepare data for analysis.
3. Differentiate between supervised and unsupervised learning techniques, and apply these methods to solve real-world problems using R.
4. Document and deploy data science projects using R, ensuring reproducibility and clarity in the presentation of results.
5. Conduct text mining using R, leveraging tools and techniques to extract insights from textual data.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO3	2	2	1	1	-	-	-	-	-	-	1	2	2	3
CO4	1	1	2	2	2	-	-	1	3	-	3	2	2	3
CO5	-	1	1	3	2	-	-	-	-	-	2	2	2	3

UNIT - I

Introduction to data science: The Data Science Process: Roles in a data science project, Stages of a data science project, Setting expectations. **Starting with R and data:** Starting with R,working with data from files. **Exploring data:** Using Summary Statistics to spot problems, Spotting problems with graphics and visualization.

UNIT - II

Managing data: cleaning data, Data transformations, Sampling for modeling and validation. **Choosing and evaluating models:** Mapping problems to machine learning tasks, evaluating models, Local interpretable model-agnostic explanations (LIME) for explaining model predictions.

UNIT - III

Supervised Learning: Using Linear Regression, Using Logistic Regression. **Unsupervised methods:** Cluster Analysis, Association rules. **Exploring Advanced Methods:** Using bagging and random forest, using generalized additive models, using kernel methods to increase data separation

UNIT - IV

Documentation and Deployment: Predicting buzz, Using R markdown to produce milestone documentation, Using comments and version control for running documentation, Deploying models. **Text Mining with R: The**

tidy text format: Contrasting tidy text with other data structures, the unnest_tokens function, tidying the works of Jane Austen, Word Frequencies.

UNIT - V

Sentiment analysis with Tidy data: The sentiments datasets, Comparing the three sentiment dictionaries, Most common positive and negative words, Word clouds, Looking at units beyond just words, **Analyzing word and document frequency**: tf-idf, Term frequency in Jane Austen's novels, Zipf's law, The bind_tf_idf() function.

Textbooks:

1. Zumel, N., Mount, J., &Porzak, J., "Practical data science with R", 2nd edition. Shelter Island, NY: Manning, 2019.
2. Julia Silge and David Robinson. "Text Mining with R: A Tidy Approach", 1st. edition. O'Reilly Media, Inc., 2017

Suggested Reading:

1. Garrett Grolemund and Hadley Wickham for data science: import, tidy, transform, visualize, and model data" O'Reilly Media, Inc., 2016.
2. Roger D. Peng, "R programming for data science" (pp. 86-181). Lean pub, 2016.

Web Resources:

1. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf
2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html
3. https://smac-group.github.io/ds/
4. https://www.geeksforgeeks.org/predictive-analysis-in-rprogramming/#:~:text=Predictive%20analysis%20in%20R%20Language,are%20used%20in %20predictive%20analysis

22CSC15N

OPERATING SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Architecture and Programming Fundamentals.

Course Objectives:

This course aims to:

1. Understand the basic concepts and design of an operating system.
2. Interpret the structure and organization of the file system.
3. Learn Inter Process Communication mechanisms and memory management approaches.
4. Explore cloud infrastructures and technologies.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the basics of Operating systems and its major components.
2. Illustrate the concepts related to process management.
3. Distinguish various memory management techniques.
4. Apply concepts of process synchronization and deadlocks to a given situation.
5. Evaluate various file allocation methods and security as well as recovery features in the designing Operating system.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	2	2	1
CO2	3	3	-	3	1	-	-	-	-	-	-	3	2	1
CO3	3	3	2	1	1	-	-	-	-	-	-	3	2	2
CO4	3	3	1	3	-	-	-	-	-	-	-	3	2	2
CO5	3	3	2	3	1	-	-	-	-	-	-	3	2	2

UNIT-I

Introduction to Operating Systems: Computer System overview, Components of a computer system, functions of OS, Examples and different types of OS *(RTOS vs. desktop vs. mobile etc.),* OS distributions and versions.
OS architectures: Micro-kernel, Layered, Kernel Approaches and examples, Linux/Unix OS Design and architecture overview.

UNIT-II

Process management: Program vs. process, process states, Process Control Block (PCB), OS services and system calls *(fork, wait, exec, getpid, getppid etc.),* system calls vs. System programs, Process scheduling-Process context switching, scheduling algorithms, scheduling criteria. Process management in Unix/Linux.
Inter Process Communication: Linux IPC Mechanisms, RPC, RPC exception handling and Security issues.

UNIT-III

Memory Management: Memory view of a process, Process memory usage requirements, virtual and physical memory related system calls *(mmap, munmap, sbrk, mprotect).* Address translation mechanisms static mapping, segmentation, paging, page faults, page replacement algorithms, page sharing, read/write permissions, swapping. Memory management in Linux/Unix. **Secondary Memory Management:** Disk structure, disk scheduling, disk management, buffering, swap space management.

UNIT-IV

Concurrency and Synchronization: Introduction to threads, benefits, types and thread APIs, Synchronization, issues, hardware and software solutions for synchronization, Classical problems of synchronization. **Deadlocks:** Introduction, necessary conditions for deadlock occurrence, RAG, deadlock handling mechanisms - prevention, avoidance and recovery.

UNIT-V

File Systems: File concepts, file types, allocation and organization methods, file handling system calls, File system metadata, directory structure, caching optimizations, File Systems case study. **OS Security and Defence:** Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits, logging, auditing, and recovery.

Textbooks:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. William Stallings, "Operating Systems Internals and Design Principles" Pearson Edition, 2012.

Suggested Reading:

1. Ekta Walia Khanna, "Operating System Concepts", 2nd Edition, Publishing House, 2019.
2. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX® Environment", 3rd Edition, Pearson Education India; 2013.
3. Maurice J. Bach, "Design of the UNIX Operating System", 1st Edition, Pearson Education India, 2015.

Online Resources:

1. Remzi H. Arpaci-Dusseau and Andrea C. , "Three Easy Pieces", Arpaci-Dusseau Books, LLC https://pages.cs.wisc.edu/~remzi/OSTEP/ (online version).
2. Frans Kaashoek, Robert Morris, and Russ Cox, Xv6, a simple Unix-like teaching operating system [T4-R] https://github.com/mit-pdos/xv6-riscv (RISC-V version) [T4-X] https://github.com/mit- pdos/xv6-public (x86 version).

22CSC21N

SOFTWARE ENGINEERING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Object-oriented programming, Programming for problem-solving, database management systems.

Course Objectives:

This course aims to:

1. Understand the Software Engineering Practice and Process Models.
2. Understand Design Engineering and Project Management in Software Development.
3. Understand the importance of testing in software development and study various testing strategies and software quality metrics.
4.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Acquire a working knowledge of software processes and models for each phase of software development.
2. Understand the agile Software process models and demonstrate the skills necessary to specify the requirements.
3. Recall the modelling concepts and estimate the cost of software using empirical models.
4. Enlist the design principles and construct a product using coding principles and standards.
5. Develop test cases and acquire skills necessary for independently developing a complete software project and estimate software quality.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	3	-	3	3	1	3	2	2	2
CO2	3	2	3	1	-	2	-	3	3	1	3	2	3	2
CO3	2	3	3	3	3	1	-	3	3	3	3	2	2	2
CO4	3	3	3	2	3	2	-	3	3	2	3	3	3	2
CO5	3	3	1	2	2	1	-	3	3	2	-	3	3	2

UNIT - I

Introduction to Software Engineering: Software Engineering Practice, The Software Process, Software Engineering Practice Process Models: A Generic Process Model, Process assessment and Improvement, Prescriptive Process Models: Waterfall Model, Incremental Process Models, RAD Model, Evolutionary Process Models - Prototyping, The Spiral Model, Specialized Process Models.

UNIT - II

An Agile Development: Agility, Agile Process, and Agile Process Models- Extreme Programming (XP), Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Feature Driven Development (FDD), Agile Modelling (AM), Requirement Engineering, Establishing the groundwork, Eliciting Requirements, Negotiating Requirements, and Validating Requirements. Software Requirements Analysis and Specification: Value of a Good SRS, Problem Analysis, Requirements Specification.

UNIT - III

Planning a software Project: Effort Estimation, Project Schedule and Staffing, Quality Planning, Risk Management, Estimation for Software Projects: Decomposition Techniques - Software Sizing, Problem-Based Estimation, An Example of LOC-Based Estimation, An Example of FP-Based Estimation, COCOMO Model

UNIT - IV

Function-oriented modelling, Design Concepts -Coupling, Cohesion, Flow-oriented modelling-DFDs with Examples, Software Architecture, A Brief Taxonomy of Architectural Styles, Component-Level Design: Definition, Basic Design Principles, Design Guidelines, Designing Traditional Components, Coding Principles and guidelines, Incremental Development of Code, Code Inspection – Planning.

UNIT - V

Testing - Testing Concepts, Testing Process, Testing Strategies: A Strategic approach to software testing, strategic issues, test strategies for Conventional Software, Validation Testing, System Testing, White Box Testing, Black Box. Automatic vs. Manual Testing, Software Review Techniques - Informal Reviews Formal Technical Reviews, Quality Concepts - What is Quality, Software Quality, Objectives, Software Quality Attributes (McCall's, HP)Deployment overview, Deployment planning, Deployment Rollback.

Textbooks:

1. Roger S. Pressman "Software Engineering: A practitioner's approach", McGraw Hill, 9th Edition, 2023.
2. Pankaj Jalote, "Software Engineering Precise Approach", Wiley Publishers, 2012

Suggested Reading:

1. Sommerville "Software Engineering", 10th Edition, Pearson, 2016.
2. Rajib Mall, *Fundamentals of Software Engineering*, 5th Edition, PHI, 2018.

Online Resources:

1. https://nptel.ac.in/courses/106101061/
2. Udemy:https://www.udemy.com/share/101BHy3@YYJn8BxwvS6cGfnCsiIlxyAlUjwZmA2xN5WmMbd8hlGxwhc4N0DF7KaEOaz4eDnMg==/

22ITC10N

COMPUTER NETWORKS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to:

1. Understand the basics of Layering Concepts, Physical layer, data transmission, and transmission media.
2. Demonstrate the state-of-the-art knowledge on data link layer concepts.
3. Distinguish the different types of routing algorithms and network layer in the Internet.
4. Introduce Transport Layer basics, UDP and TCP Protocols.
5. Know the concepts of Application Layer Protocols.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Explain the functions of each layer in the OSI, TCP/IP reference models and demonstrate the concepts of Physical Layer.
2. Analyse the Data Link Layer protocols and MAC mechanisms.
3. Evaluate the Routing algorithms and the IP Protocols.
4. Illustrate the functions and performance of Internet Transport Protocols TCP and UDP.
5. Explore the various Application layer protocols.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	0	0	0	0	0	0	2	3	2
CO2	3	3	3	2	1	0	0	0	0	0	0	3	3	2
CO3	3	3	2	2	3	0	0	0	0	0	0	3	3	2
CO4	3	3	2	2	2	0	0	0	0	0	0	3	3	3
CO5	2	2	1	2	3	3	3	2	3	3	3	3	3	2

UNIT-I

Introduction: Network Hardware, Network Topologies, Reference Models- The OSI Reference Model- the TCP/IP Reference Model – A Comparison of the OSI and TCP/IP Reference, Packet Switching, Circuit Switching and Virtual Circuit Switching. Physical Layer: Guided Transmission media, Twisted Pairs, Coaxial Cable, Fiber Optics, Wireless transmission.

UNIT-II

Data Link Layer: Design Issues, Error Detection and Correction, Elementary Data Link Protocols: Simplex Protocol, A Simplex Stop and Wait Protocol for an Error-free channel, Sliding Window Protocols, Go-Back-N, Selective Repeat. Medium Access Sub Layer: The Channel allocation problem, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols.

UNIT- III

Network Layer: Design Issues, Routing algorithms: The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, OSPF, BGP, Quality of Service, The Network layer in the Internet- The IP Version 4 Protocol, IP Addresses, IP Version 6.

UNIT-IV

Transport Layer: Transport Service, Berkeley Sockets, Elements of Transport Protocols, **The Internet Transport Protocols:** Introduction to UDP, The TCP Protocol, The TCP Segment Header, The TCP Connection Establishment, TCP Connection Release, TCP Sliding Window, TCP Timer Management, TCP Flow Control, Congestion

Control.

UNIT-V

Application Layer: DNS, The Domain Name System, The DNS Name Space, Domain Resource Records, Name Servers. **Electronic MAIL:** Architecture and Services, the User Agent, Message Formats, Message Transfer, Final Delivery, SMTP, FTP, TELNET, SNMP.

TEXT BOOKS:

1.Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2014.

SUGGESTED READING:

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2021.
2.Chwan-Hwa (John) Wu, J. David Irwin, "Introduction to Computer Networks and Cyber Security", CRC Press, 2013.
3.W. Richard Stevens, "Unix Network Programming", Prentice Hall/Pearson Education, 2009.
4.James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 5th Edition, Addison-Wesley, 2012.
5.Larry L. Peterson and Bruce S. Davie "Computer Networks: A Systems Approach", 5e, 2018
6.Behrouz A. Forouzan "Data Communications and Networking", Fourth Edition, 2007.

WEB RESOURCES:

1. https://nptel.ac.in/courses/117105148,title of the course
2. Computer Networks - Books, Notes, Tests 2025-2026 Syllabus
3. IEEE Transactions on Networking | IEEE Communications Society
4. Web Resources for Computer Networks, 5 (vu.nl)

22ADE56N

FEDERATED MACHINE LEARNING

(Professional Elective#2)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: Machine Learning

COURSE OBJECTIVES: This course aims to:

1. Introduce the theoretical foundations of Federated Learning (FL)
2. Familiarize with mathematical models and algorithms including Federated Averaging, Secure Multi-Party Computation, and Differential Privacy.
3. Explore the privacy threat models and security mechanisms involved in FL, including homomorphic encryption and secure aggregation.
4. Delve into the scalability challenges in FL and study scalability-oriented distributed machine learning schemes.
5. Examine advanced topics in FL theory, including Federated transfer learning, fairness-aware Profit-sharing frameworks, and federated reinforcement learning.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Comprehend theoretical principles of Federated Learning and its applications in privacy-preserving machine learning.
2. Interpret the concepts, platforms, and privacy-preserving techniques used in distributed machine learning.
3. Summarize the architecture, algorithms, and security aspects of horizontal and vertical federated learning.
4. Describe the concepts of federated transfer learning, secure computation, and fairness in contribution reward systems
5. Interpret the application of federated learning in computer vision, natural language processing, recommendation systems, and reinforcement learning.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	1	2	2
CO2	1	2	1	1	1	-	-	-	-	-	-	2	1	2
CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	2
CO4	1	1	1	1	2	1	-	-	-	-	-	2	2	2
CO5	2	1	-	1	2	-	-	-	-	-	-	2	2	2

UNIT - I

Introduction: Motivation, Federated Learning as a Solution, The Definition of Federated Learning, Categories of Federated Learning, Current Development in Federated Learning, Research Issues in Federated Learning, Open-Source Projects, Standardization Efforts, The Federated AI Ecosystem Background: Privacy-Preserving Machine Learning, PPML and Secure ML, Threat and Security Models, Privacy Threat Models, Adversary and Security Models, Privacy Preservation Techniques, Secure Multi-Party Computation, Homomorphic Encryption, Differential Privacy **.**

UNIT - II

Distributed Machine Learning: Introduction to DML, The Definition of DML, DML Platforms, Scalability

Motivated DML, Large-Scale Machine Learning, Scalability-Oriented DML Schemes, Privacy-Motivated DML, Privacy-Preserving Decision Trees, Privacy-Preserving Techniques, Privacy-Preserving DML Schemes, Privacy-Preserving Gradient Descent, Vanilla Federated Learning, Privacy-Preserving Methods.

UNIT - III

Horizontal Federated Learning: The Definition of HFL, Architecture of HFL, The Client- Server Architecture, The Peer-to-Peer Architecture, Global Model Evaluation, The Federated Averaging Algorithm, Federated Optimization, The FedAvg Algorithm, The Secured FedAvg Algorithm, Improvement of the FedAvg Algorithm, Communication Efficiency, Client Selection Vertical Federated Learning: The Definition of VFL, Architecture of VFL, Algorithms of VFL, Secure Federated Linear Regression, Secure Federated Tree-Boosting

UNIT - IV

Federated Transfer Learning: Heterogeneous Federated Learning, Federated Transfer Learning, The FTL Framework, Additively Homomorphic Encryption, The FTL Training Process, The FTL Prediction Process, Security Analysis, Secret Sharing-Based FTL Incentive Mechanism Design for Federated Learning: Paying for Contributions, Profit- Sharing Games, Reverse Auctions, A Fairness-Aware Profit Sharing Framework, Modeling Contribution, Modeling Cost, Modeling Regret, Modeling Temporal Regret, The Policy Orchestrator, Computing Payoff Weightage

UNIT - V

Federated Learning for Vision, Language, and Recommendation: Federated Learning for Computer Vision, Federated CV, Federated Learning for NLP, Federated NLP, Federated Learning for Recommendation Systems, Recommendation Model, Federated Recommendation System Federated Reinforcement Learning: Introduction to Reinforcement Learning, Policy, Reward, Value Function, Model of the Environment, RL Background Example, Reinforcement Learning Algorithms, Distributed Reinforcement Learning, Asynchronous Distributed Reinforcement Learning, Synchronous Distributed Reinforcement Learning, Federated Reinforcement Learning, Background and Categorization

TEXTBOOK:

1. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu Synthesis Lectures on Artificial Intelligence and Machine Learning 2019.

SUGGESTED READING:

1. Kiyoshi Nakayama, George Jeno, Federated Learning with Python, Packt Publisher, October 2022.

WEB RESOURCES:

1. https://www.tensorflow.org/federated
2. https://courses.openmined.org/courses/federated-learning-on-mobile
3. https://flower.ai/docs/framework/tutorial-series-what-is-federated-learning.html

22ADE57N

APPLIED PREDICTIVE ANALYTICS

(Professional Elective#2)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on Data Mining and Statistics.

Course Objectives:

This course aims to:

1. Understand predictive analytics and its challenges.
2. Learn the descriptive modeling algorithms used for predictive software.
3. Identify relationships that associate inputs with one or more target variables in supervised learning models.
4. Gain knowledge on predictive modeling approaches to textual data.
5. Familiarize with various deployment models.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Analyze key characteristics of data for modeling.
2. Apply clustering techniques and interpret the meaning of the resulting clusters.
3. Assess model accuracy to select and deploy the best model.
4. Extract features from textual data and build predictive models for textual data.
5. Understand various deployment models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	-	-	-	1	-	2	2	2	2
CO2	3	2	1	2	1	-	-	-	1	-	2	1	1	2
CO3	3	2	2	2	1	-	-	-	1	-	2	3	3	3
CO4	3	2	1	2	2	-	-	-	1	-	3	3	3	3
CO5	2	1	1	3	2	-	-	-	-	-	2	2	2	3

UNIT - I

Overview of Predictive Analytics: What Is Predictive Analytics? Business Intelligence, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining, Challenges in Using Predictive Analytics.

UNIT - II

Descriptive Modeling: Data Preparation Issues with Descriptive Modeling, Principal Component Analysis, Clustering Algorithms, the K-Means Algorithm, the Kohonen SOM Algorithm.

Interpreting Descriptive Models: Standard Cluster Model Interpretation, Problems with Interpretation Methods, and Identifying Key Variables in Forming Cluster Models, Cluster Prototypes, and Cluster Outliers.

UNIT - III

Predictive Modeling: Decision Trees, Logistic Regression, Neural Networks, K-Nearest Neighbor, Naïve Bayes, Regression Models, Linear Regression, Other Regression Algorithms.

Assessing Predictive Models: Batch Approach to Model Assessment, Percent Correct Classification, Rank-Ordered Approach to Model Assessment, Assessing Regression Models.

UNIT - IV

Text Mining: A Predictive Modeling Approach to Text Mining, structured vs. Unstructured Data, Why Text Mining Is Hard, Data Preparation Steps, Text Mining Features, Modeling with Text Mining Features, Regular Expressions.

UNIT - V

Model Deployment: General Deployment Considerations, Sampling Considerations for Rebuilding Models, Champion-Challenger sampling.

Case Studies: Survey Analysis Case Study: Overview, Deployment: "What-If" Analysis, Help Desk Case Study, Revisit Business Understanding.

Textbooks:

1. Abbott, Dean. Applied predictive analytics: Principles and techniques for professional data analyst. John Wiley & Sons, 2014.
2. McCarthy, Richard V., et al. applying predictive analytics. Springer International Publishing, 2022.

Suggested Reading:

1. Larose, Daniel T. Data mining and predictive analytics. John Wiley & Sons, 2015.
2. Gupta, Deepti. Applied analytics through case studies using Sas and R: implementing predictive models and machine learning techniques. Apress, 2018.

Web Resources:

1. https://nptel.ac.in/courses/111106164
2. https://www.coursera.org/learn/hands-on-introduction-to-linux-commands-and-shell-scripting?utm_medium=sem&utm_source=gg&utm_campaign=b2c_india_courseraplus_coursera_ftcof_subscription_arte_sep-23_dr_sem_rsa_gads_lg-all&campaignid=20590309416&adgroupid=155702724684&device=c&keyword=coursera&matchtype=e&network=g&devicemodel=&adposition=&creativeid=675426312952&hide_mobile_promo=&gad_source=1&gclid=Cj0KCQjwpNuyBhCuARIsANJqL9PccGXJHurPtsMiQyCbIKqK4mV5XvgkL9rjuIFhzB8Mj1x0B4eoeCMaArzREALw_wcB#modules
3. https://www.coursera.org/learn/predictive-modeling-analytics

22ADE58N

BUSINESS INTELLIGENCE

(Professional Elective#2)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: Python, SQL

COURSE OBJECTIVES*:*

This course aims to:

1. Understand students with a foundational understanding of the evolution of Business Intelligence and Artificial Intelligences.
2. To enable students to explore various BI implementation dimensions, understand the alignment between business goals and BI strategies.
3. To familiarize students with core BI technologies including analytical methods.
4. To introduce students to the modern tools to learn in business analytics, including R, Python, Tableau, Power BI.
5. To develop an understanding of practical BI applications in functional business areas through real-world case studies.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Understand the evolution of BI and AI, their roles in business decision-making, and differentiate between types of analytics.
2. Evaluate methods for integrating data and information, ensuring quality, semantic consistency, and relevance to decision-making.
3. Apply descriptive, predictive, and prescriptive analytics using big data and AI to derive insights and support business decisions.
4. Discuss current and emerging AI-based trends in BI including cloud computing, IoT, 5G, GIS, and the metaverse.
5. Analyze real-world BI applications in marketing, finance, and operations through case studies of data-driven decision-making.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	-	-	2	2	2
CO2	-	1	1	1	-	-	-	-	-	-	-	1	1	2
CO3	2	1	1	1	-	-	-	-	-	-	-	2	1	2
CO4	2	1	1	1	-	-	-	-	-	-	-	1	1	2
CO5	-	1	1	1	-	-	-	-	-	-	-	1	1	2

UNIT-I

Foundations of Business Intelligence and AI: Evolution of BI and AI, Business decision-making processes and decision support, Types of analytics: Descriptive, Predictive, Prescriptive, Artificial Intelligence: definitions, technologies, and applications, AI in various business domains: marketing, finance, HR, robotics, chatbots. (TB-1-Chapter-1,2)

UNIT - II

BI Dimensions and Information Integration: BI implementation dimensions (centralized vs. decentralized, real-time, automation, scope), Business and BI alignment, Data vs. Information integration, Data quality, semantics, and context, Tools and methods for integration. (TB-2-Chapter-4,5)

UNIT - III

BI Technologies and Analytical Approaches: BI technology stack: Data warehousing, OLAP, reporting tools, Business analytics: Descriptive, Predictive, Prescriptive, Big Data and data mining, Visualization tools and dashboards, AI's role in BI (e.g., machine learning, augmented analytics) (TB-2-Chapter-7)

UNIT – IV

Tools, Trends: Landscape of Business Analytics Tools, BI tools: R, Python, KNIME, Tableau, Orange, RapidMiner, AI-Based Trends in Analytics and Data Science, Cloud computing, IoT, 5G, RPA, GIS, and metaverse. (TB-1-Chapter-9,10)

UNIT – V

Business Applications, Ethics, and Emerging Trends: BI in Marketing, Finance, and Operations; Case Studies on Data-Driven Decision Making, Ethics in BI and Data Mining, Risk Management using BI Tools, Competitive Intelligence and Strategic BI, AI Integration with BI Platforms, Future of BI and Intelligent Decision Systems. (TB-1-Chapter10)

TEXTBOOKS:

1. "Business Intelligence, Analytics, Data Science, and AI: A Managerial Perspective" by Ramesh Sharda, Dursun Delen, and Efraim Turban (5th Edition).
2. "Business Intelligence: A Comprehensive Approach to Information Needs, Technologies and Culture" by Rimvydas Skyrius.

SUGGESTED READING:

1. Business Intelligence: A Managerial Perspective on Analytic, Ramesh Sharda, Dursun Delen, Efraim Turban, Pearson, Global Edition, 4th Edition
2. Greg Deckler, Brett Powell - Mastering Microsoft Power BI_ Expert techniques to create interactive insights for effective data analytics and business intelligence, 2nd Edition-Packt Publishing.
3. Fundamental of Business Intelligence, Grossmann W, Rinderle,2015

WEB RESOURCES:

1. https://www.youtube.com/watch?v=6KAVCI2iIVA
2. https://www.coursera.org/learn/business-intelligence-data-analytics
3. https://onlinecourses.nptel.ac.in/noc24_cs65/preview
4. https://trainings.internshala.com/business-analytics-course/

22ADE59N

PRINCIPLES OF CRYPTOGRAPHY

(Professional Elective#2)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Networks.

Course Objectives:

This course aims to:

1. Make students learn the basic principles of computer and network security, including attacks, services, and models.
2. Familiarize students with essential number theory concepts used in cryptographic algorithms.
3. Enable students to understand the design and working of symmetric and asymmetric encryption algorithms like DES, AES, and RSA.
4. Make students understand cryptographic hash functions, message authentication codes, and digital signature schemes to ensure data integrity and authenticity.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define fundamental concepts of computer security, distinguish types of attacks, and describe network security models.
2. Apply principles of number theory, modular arithmetic and Euler's theorem, to solve problems in cryptographic algorithms.
3. Use block ciphers such as DES and AES for Cryptographic operations.
4. Implement public key cryptographic techniques and cryptographic hash functions to achieve secure data transmission.
5. Utilize the message authentication codes and digital signature schemes to ensure data integrity and authenticity.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	-	2	2	2
CO2	-	1	1	1	-	-	-	-	-	-	-	1	1	2
CO3	2	1	1	1	-	-	-	-	-	-	-	2	1	2
CO4	2	1	1	1	-	-	-	-	-	-	-	1	1	2
CO5	-	1	1	1	-	-	-	-	-	-	-	1	1	2

UNIT-I

Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security.

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT-II

Introduction to Number Theory: Divisibility and Division Algorithm, Euclidean algorithm, Modular arithmetic, Prime Numbers, Fermat's theorem and Euler's theorem, Discrete Logarithms.

Unit-III

Block Ciphers and Data Encryption Standard: Traditional Block Cipher Structure, the Data Encryption

Standard, DES Example, the Strength of DES, Block Cipher Design Principles, Multiple Encryption, Triple DES

Advanced Encryption Standard: Finite Field Arithmetic, AES Structure, AES Transformation functions, AES Key Expansion, AES Example, AES Implementation.

UNIT-IV

Asymmetric Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie Hellman key exchange, Distribution of Public Keys, X.509 Certificates.

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA-512).

UNIT-V

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions HMAC, Security of HMAC.

Digital Signatures: Digital Signature, ElGamal Digital Signature Scheme, NIST Digital Signature Algorithm.

TEXTBOOK:

1. William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson Education, Seventh Edition,2017.

REFERENCE BOOKS:

1. V.K.Jain, “Cryptography and Network Security”, First Edition, Khanna Book Publishing,2013.
2. Behrouz A Forouzan, "Cryptography and Network Security", Second Edition, Tata McGraw Hill, 2010.

WEB RESOURCES:

1. https://www.coursera.org/learn/crypto
2. https://www.simplilearn.com/learn-cryptography-basics-free-skillup-course
3. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-cryptography
4. https://cryptohack.org/

22ADE50N

NATURAL LANGUAGE PROCESSING WITH TRANSFORMERS

(Professional Elective#2)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: Deep Learning

COURSE OBJECTIVES: This course aims to:

1. Understand the Transformer Architecture
2. Get familiar with models like BERT, GPT, Roberta, T5, and Distil BERT.
3. Learn how to fine-tune these models for downstream tasks
4. Understand Tokenization & Embeddings
5. Apply Transformers to NLP Tasks.

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Apply text preprocessing techniques such as tokenization, stop word removal, POS tagging, and vectorization on natural language data.
2. Make use of pre-trained deep learning models like BiLSTM and CRF for sentiment analysis and named entity recognition.
3. Explain the application of transfer learning techniques using pretrained GloVe and BERT models for natural language understanding.
4. Describe pretrained models like RNNs, Seq2Seq with attention, and GPT-2 used for text generation and summarization.
5. Apply pretrained multi-modal models for performing vision-language tasks such as image captioning using transformers and weak supervision.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	2	-	-	-	-	-	2	2	1	3
CO2	3	2	1	-	2	-	-	-	-	-	2	2	1	3
CO3	3	2	1	-	2	-	-	-	-	-	2	2	1	3
CO4	3	2	1	-	2	-	-	-	-	-	2	2	1	3
CO5	3	2	1	-	2	-	-	-	-	-	2	2	1	3

UNIT - I

Essentials of NLP: A typical text processing workflow, Data collection and labeling, Collecting labeled data, Text normalization, Modeling normalized data Tokenization: Segmentation, Modeling tokenized data. Stop word removal: Modeling data with stop words removed. Part-of-speech tagging: Modeling data with POS tagging Stemming and lemmatization, Vectorizing text: Count-based vectorization, Modeling after count-based vectorization, Term Frequency-Inverse Document Frequency (TF-IDF): Modeling using TF-IDF features, Word vectors: Pertained models using Word2Vec embedding.

UNIT - II

Understanding Sentiment in Natural Language with BiLSTMs : Bi-directional LSTMs (BiLSTMs), RNN building blocks, Long short-term memory (LSTM) networks, Gated recurrent units (GRUs), Sentiment

classification with LSTMs, Loading the data, Normalization and vectorization, LSTM model with embeddings, BiLSTM model , Named Entity Recognition, The GMB data set, Loading the data, Normalizing and vectorizing data, A BiLSTM model, Conditional random fields (CRFs), NER with BiLSTM and CRFs, Viterbi decoding.

UNIT - III

Transfer Learning with BERT: Transfer learning overview, Types of transfer learning, Domain adaptation, Multi-task learning, Sequential learning, IMDb sentiment analysis with Glove embeddings: Glove embeddings, Loading IMDb training data, Loading pre-trained Glove embeddings, Creating a pre-trained embedding matrix using Glove, Feature extraction model, Fine-tuning model: BERT-based transfer learning, Encoder-decoder networks, Attention model, Transformer model, The bidirectional encoder representations from transformers (BERT) model, Tokenization and normalization with BERT Pre-built BERT classification model, Custom model with BERT

UNIT - IV

Generating Text with RNNs and GPT-2: Generating text – one character at a time, Data loading and pre-processing, Data normalization and tokenization, Training the model, Implementing learning rate decay as custom callback, Generating text with greedy search, Generative Pre-Training (GPT-2) model, Text Summarization with Seq2seq: Overview of text summarization, Data loading and pre-processing, Data tokenization and vectorization, Seq2seq model with attention, Encoder model, Bahdanau attention layer, Decoder model, Training the model, Generating summaries, Greedy search, Beam search, Decoding penalties with beam search, Evaluating summaries, ROUGE metric evaluation

UNIT - V

Multi-Modal Networks and Image: Multi-modal deep learning, Vision and language tasks, Image captioning, MS-COCO dataset for image captioning, The Transformer model: Positional encoding and masks, Scaled dot-product and multi-head attention, Visual Encoder, Decoder, Transformer, Training the Transformer model with Visual Encoder, Generating captions, Improving performance and state-of-the-art models, Weak supervision, Using weakly supervised labels to improve IMDb sentiment analysis, Weakly supervised labeling with Snorkel, Naïve-Bayes model for finding keywords.

TEXTBOOK:

1. Ashish Bansal, Advanced Natural Language Processing with TensorFlow 2, PACKT Publisher, First Edition, 2021.

SUGGESTED READING:

1. Thushan Ganegedara - Natural Language Processing with TensorFlow_ Teach Language to Machines Using Python's Deep Learning Library, PACKT, 2018

WEB RESOURCES:

1. https://www.tensorflow.org.
2. https://www.nltk.org
3. https://www.deeplearning.ai/resources/natural-language-processing/

22ADC53N

ADVANCED ARTIFICIAL NEURAL NETWORKS LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Prerequisite: Python Programming

Course Objectives:

This course aims to:

1. Implement deep learning architectures like perceptron's, MLPs, and CNNs for classification tasks.
2. Apply and compare optimization techniques such as SGD, Momentum, and Adam.
3. Utilize regularization methods like L1, L2, and dropout to enhance model generalization.
4. Perform hyperparameter tuning using grid or random search to optimize model performance.
5. Solve real-world problems like image and text classification using deep learning models

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design and evaluate deep learning models for binary and multi-class classification.
2. Optimize models using various gradient-based techniques and analyze their performance.
3. Apply regularization to improve model robustness and reduce overfitting.
4. Tune hyperparameters to achieve optimal model accuracy and efficiency.
5. Build and evaluate sequential models for real-time, sequence-based applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	-	-	-	-	-	-	2	2	3
CO2	3	3	2	3	3	-	-	-	-	-	-	2	2	3
CO3	3	3	2	3	3	-	-	-	-	-	-	2	2	3
CO4	3	3	2	3	3	-	-	-	-	-	-	2	2	3
CO5	3	3	2	3	3	-	-	-	-	-	-	2	2	3

LIST OF PROGRAMS:

1. Implement a single-layer perception and Sigmoid for binary classification on a synthetic dataset
2. Implementation of Classification with Multilayer Perceptron with MNIST Dataset.
3. Compare the Performance of the Classification models by Tuning Hyperparameters.
4. Construct CNN for classification on MNIST Dataset
5. Implement Deep Learning models like Alex Net, VGGNet and Dense Net and compare their performance
6. Implementation of ResNet, Googlenet for image classification
7. Implementation of RNN for text classification
8. Implement LSTM and Bidirectional LSTM for sentiment analysis
9. Implementation of Encoder Decoder Models with attention for machine translation
10. Implementation of GAN Model

SUGGESTED BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron, Courville, "Deep Learning", MIT Press, 2016

2. Indra den Bakker, “Python Deep Learning Cookbook”, PACKT publisher, 2017
3. Wei Di, Anurag Bhardwaj, Jianing Wei, “Deep Learning Essentials”, Packt publishers, 2018

22ADC54N

INTRODUCTION TO DATA SCIENCE LAB

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. To introduce data structures in R.
2. To familiarize with data types and file formats.
3. To gain knowledge on data preprocessing and data visualization.
4. To acquaint with supervised and unsupervised learning algorithms.
5. To explore various case studies.

Course Outcomes:

Upon completion of this course, students will be able to:

1. **Identify and utilize appropriate data structures in R** for efficient data storage and manipulation.
2. **Explain various data types and file formats**, selecting suitable options for handling real-time data.
3. **Apply data preprocessing techniques** to clean and prepare raw data for analysis, as well as create effective data visualizations.
4. **Differentiate between supervised and unsupervised learning algorithms**, applying these methods to analyze and interpret data.
5. **Analyze and discuss findings from various case studies**, demonstrating the application of data science principles in real-world scenarios.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	-	-	1	-	-	2	2	2	3
CO2	2	2	1	2	2	-	-	1	-	-	2	1	1	3
CO3	2	2	1	2	2	-	-	1	1	-	2	3	2	3
CO4	2	2	2	3	2	-	-	1	2	-	3	3	3	3
CO5	1	2	1	3	2	-	-	1	1	-	3	3	3	3

List of Programs

1. Implementation of R programming basics including Operators, data types, Variables, String manipulations etc.
2. Demonstrate the usage of R data structures. (List, Vectors, Matrices, Data frames, Factors)
3. Analyzing different file formats in R. (Data frames, CSV, TSV, Excel Files, XML, Json, HTML)
4. Implementation of preprocessing techniques on any two datasets.
5. Visualize data using R packages and apply data manipulation - dplyr, data. Table, reshape2, tidyr, etc., and provide your inference.
6. Visualize the importance of LIME.
7. Build a linear regression model and logistic regression model, check the model on test data and predict the numerical quantities.
8. Demonstrate Association rule Technique.
9. Explore text mining techniques and sentiment analysis.

Textbooks:

Chaitanya Bharathi Institute of Technology (A)

1. Zumel, N., Mount, J., &Porzak, J., “Practical data science with R”, 2nd edition. Shelter Island, NY: Manning, 2019.
2. Julia Silge and David Robinson. “Text Mining with R: A Tidy Approach”, 1st. edition. O'Reilly Media, Inc., 2017.

Suggested Reading:

1. Garrett Grolemund and Hadley Wickham,” R for data science: import, tidy, transform, visualize, and model data” O’Reilly Media, Inc., 2016.
2. Roger D. Peng, “R programming for data science” (pp. 86-181). Lean pub, 2016.

Web Resources:

1. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf
2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html

22ADC55N

MINI PROJECT

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

COURSE OBJECTIVES:

1. To enable students learning by doing.
2. To develop the capability to analyze and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Interpret literature with the purpose of formulating a project proposal.
2. Plan, Analyze, Design and Implement a project.
3. Find the solution of identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver presentation before the Departmental Committee.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	2	1	2	3	2	3	2
CO2	3	3	3	3	3	3	3	2	1	2	3	1	3	2
CO3	3	3	3	3	3	3	3	2	-	2	3	3	3	2
CO4	2	2	2	3	3	3	3	2	3	3	2	2	3	2
CO5	1	2	1	2	3	3		-	2	3	-	2	3	-

The students are required to choose a topic for a mini project related to the courses of the current semester or previous semester. The student must implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) must be followed. Report of the project work has to be submitted for evaluation.

Schedule

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Design, Implementation and Testing of the Project	7 weeks
4.	Documentation and Project Presentation	4 weeks

Guidelines for the Award of Marks

S No	Description	Max. Marks
1.	Weekly Assessment	20
2.	PPT Preparation	5
3.	Presentation	10
4.	Question and Answers	5
5.	Report Preparation	10

Final Mini Project demonstration and PPT presentation is to be evaluated for the entire class together by all the faculty handling Mini Project for that class.

22ADI02

INDUSTRIAL INTERNSHIP/ RURAL INTERNSHIP

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

PREREQUISITE: Knowledge of Basic Sciences and Engineering Sciences/Knowledge about rural environment

COURSE OBJECTIVES: This course aims to:

1. Exposing the students to the industrial environment/ rural environment
2. Create awareness on the current industrial technological developments in the domain of IT
3. Provide opportunity to understand the social, economic feasibility aspects in the process of product/prototypedevelopment

COURSE OUTCOMES: Upon completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics
2. Use state of the art Tools and technologies
3. Provide innovative solutions to solve real world problems
4. Acquire knowledge in technical reports writing and presentation
5. Apply technical knowledge to real world industrial/rural situations

.**Course Articulation Matrix:**

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	-	-	-	-	-	3	-	3	-	3	3	2	2	3
CO 2	1	1	1	3	3	2	1	-	-	-	-	3	3	2
CO 3	2	3	3	3	3	3	1	1	-	-	-	3	3	3
CO 4	-	-	-	-	-	3	1	3	3	-	1	2	2	3
CO 5	1	3	3	3	3	3	-	1	-	-	1	3	3	3

For implementation procedures and letter formats, annexures I and III of Internship document may be referred.

Evaluation of Internship: The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent)
b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks)
c) Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks)

Evaluation through Seminar presentation/Viva-Voce at the institute: Students shall give a seminar before an E*xpert Committee* constituted by college (Director, HoD/Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out

The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills
- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

Monitoring/ Surprise Visits: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training/internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER-VI

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
		THEORY						
1.	22ADC61N	Artificial Intelligence	3	-	3	40	60	3
2.	22CIC07N	Industrial Internet of Things	3	-	3	40	60	3
3.	22ITC29N	Cloud Computing	3	-	3	40	60	3
4.		Professional Elective – 3	3	-	3	40	60	3
5.		Professional Elective – 4	3	-	3	40	60	3
6.		Open Elective – 1	3	-	3	40	60	3
		PRACTICAL						
7.	22ADC62N	Artificial Intelligence Lab	-	3	3	50	50	1.5
8.	22CIC25	Internet of Things Lab	-	3	3	50	50	1.5
9.	22EGC03	Employability Skills	-	2	3	50	50	1
10.	22ADU02	Upskill Certification Course	--	-	-	-		0.5
TOTAL			**18**	**8**		**390**	**510**	**22.5**
		Clock Hours Per Week: 26						

L: Lecture **T: Tutorial** **CIE – Continuous Internal Evaluation**
D: Drawing **P: Practical** **SEE - Semester End Examination**

Professional Elective #3	Image and Video Analytics (22ADE63N)	Scalable web Application Development (22ITE10)	Introduction to UAV Systems (22ADE64N)	Cyber Security Essentials (22ITE23)	Social Network Analytics (22ADE65N)
Professional Elective #4	User Interface and User Experience Design (22CSE08)	High Performance Computing (22CSE09N)	Serverless Computing (22ITE17)	Ethical Hacking (22CIE07)	Data Engineering (22ADE66N)
Open Elective #1	Bioterrorism and National Security (22BTO03)	Fundamentals of Quantum Computing (22MTO01)	Technical Writing Skills (22EGO01)	Optimization Techniques (22MTO02)	Organizational Behavior (22MBO03)

22ADC61N

ARTIFICIAL INTELLIGENCE

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn basics of AI and concept of Intelligent Agent.
2. To learn the various Searching techniques
3. To learn first order and second order predicate Logic to infer knowledge
4. To learn classical and real-world planning approaches
5. To learn uncertainty and probabilistic reasoning models

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Explain the fundamentals of Artificial Intelligence and the role of intelligent agents in diverse environments.
2. Compare and evaluate uninformed and informed search techniques for problem-solving in AI.
3. Apply propositional and first-order predicate logic to represent knowledge and infer conclusions.
4. Analyse classical and real-world planning strategies and interpret knowledge representation approaches in complex domains.
5. Understand and apply probabilistic reasoning models to handle uncertainty in intelligent systems.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	2	2	1	3
CO2	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO3	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO4	3	2	1	-	-	-	-	-	-	-	2	2	1	3
CO5	3	2	1	-	-	-	-	-	-	-	2	2	1	3

UNIT-I

Introduction: AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art ; Intelligent Agents : Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; Solving Problems by Searching: Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

UNIT-II

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches; Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

UNIT-III

Logical Agents : Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic; Inference in First-Order Logic: Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

UNIT-IV

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; Planning and Acting in the Real World: Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; Knowledge Representations: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

UNIT-V

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes 'Rule and Its Use, The Wumpus World: Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Probabilistic Reasoning over Time: Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

Textbooks:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4th Edition

Suggested Reading:

1. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi , ―Artificial Intelligence: Building Intelligent Systems‖, PHI, 2015
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs19/
2. https://www.coursera.org/learn/ai-for-everyone

22CIC07N

INDUSTRIAL INTERNET OF THINGS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60Marks
CIE	40Marks
Credits	3

Pre-Requisites
Computer Architecture and Micro Processor, Programming for Problem Solving.

Course Objectives

1. Understand the basics of IoT and IIOT.
2. Impart necessary and practical knowledge in Industrial Internet of Things.
3. Develop skills required to build real-time IIoT based projects.

Course Outcomes

By the end of this course, students should be able to:
1. Understand Internet of Things and IIOT basics components.
2. Analyzing IoT Systems: Sensor Interfaces, Protocols, and Communication Modules.
3. Applying Raspberry Pi in IoT: Interface Sensors and Actuators
4.Understanding Arduino Basics
5. Develop real-time IoT-based projects.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	1	-	-	1	3	2	1
CO2	1	-	-	-	-	-	-	1	-	-	1	3	3	1
CO3	1	1	1	-	1	-	-	1	1	-	1	3	3	2
CO4	1	1	1	-	1	-	-	1	1	-	1	3	3	1
CO5	2	2	1	1	2	1	1	1	1	1	1	3	3	2

Unit – I
Internet of Things: The Third Wave? Definition of IoT, and M2M, Advantages and Disadvantages of IoT.More than Smart "Things": IoT key attributes, Three Major Challenges Facing IoT, Architecture of IoT.

Industrial Internet of Things (IIoT): Definition of IIoT, IoT, and M2M, IIoT Challenges, IIoT Requirements.

Unit – II
Physical design of IoT: Sensors, Networks, Standards. Things in IoT, IoT protocols, Intelligent analysis, Intelligent actions
Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs.

Unit – III
Raspberry Pi: IoT Physical Devices and Endpoints: Introduction to Raspberry Pi-Interfaces (serial, SPI, I2C), Programming Raspberry PI with Python- Controlling LED with Raspberry PI, interfacing an LED and Switch with Raspberry PI, and Interfacing a light sensor (LDR) with Raspberry Pi.

Unit – IV

Programming Arduino: Introduction, Arduino Boards, Programming Variables, if, loops, functions, digital inputs and outputs, the serial monitor, analog inputs and outputs, using libraries, Arduino data types and commands. Programming Arduino Uno with Arduino- Controlling LED with Arduino, interfacing an LED and a Switch with Arduino.

Unit – V

Domain-specific applications of IoT: Hom Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health, and lifestyle.

Textbooks:

1. Ahmed Banafa by Introduction to Internet of Things (IoT) Published 2023 by River Publishers
2. Jivan S. Parab · Madhusudan Ganuji Lanjewar · Marlon Darius Sequeira · Gourish Naik · Arman Yusuf Shaikh by Python Programming Recipes for IoT Applications, Springer Nature Singapore Pte Ltd. 2023.
3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, 2014, VPT publishers
4. Simon Monk, Programming Arduino Next Steps: Going Further with Sketches, Second Edition,2019.

Reference Books:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).
4. R2. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
5. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2017.
6. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media, 2011.

Web References:

1. Li Da Xu, Wu He, and Shancang Li, "Internet of Things in Industries: A Survey", IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik , JP. Vasseur, R. Alexander, "RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks", IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, "The Constrained Application Protocol (CoAP)", Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, "What's The Difference Between IEEE 802.15.4 And ZigBee Wireless?", Electronic Design (Online), Mar. 2013.

22ITC29N

CLOUD COMPUTING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on Data Bases and computing mechanisms.

Course Objectives:

This course aims to:

1. Gain a comprehensive understanding of fundamental concepts in cloud computing, including its goals, benefits, risks, challenges, service models, and deployment models.
2. Explore cloud-enabling technologies such as cloud data center technology, virtualization, multitenant technology, and containerization, along with their roles and implications in cloud computing environments.
3. Analyze specialized cloud mechanisms and management mechanisms to understand their significance in optimizing cloud performance and resource utilization.
4. Examine various access-oriented and data-oriented security mechanisms implemented in cloud computing environments
5. Evaluate different cloud computing architectures to design scalable, resilient, and efficient cloud solutions aligned with organizational requirements and objectives.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the fundamental cloud computing concepts, including service models and deployment models.
2. Analyze cloud-enabled technologies and evaluate various cloud infrastructure components, storage technologies, and networking principles.
3. Apply the advanced cloud computing mechanisms and cloud management mechanisms
4. Analyze the security challenges, identify potential risks, and evaluate strategies for securing cloud deployments.
5. Critique different cloud computing architectures, evaluating their scalability, resilience, and suitability for diverse application scenarios leverage emerging trends such as edge computing and fog computing

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	2	3	1	3	2	2
CO2	3	3	2	2	1	1	1	1	2	3	1	3	3	2
CO3	3	3	2	2	1	1	1	1	2	3	1	3	3	2
CO4	3	3	2	2	1	1	1	1	2	3	1	3	3	2
CO5	3	3	3	2	1	1	1	1	2	3	1	3	3	2

UNIT - I

Fundamental Concepts of Cloud Computing: Goals and Benefits, Risks and Challenges, Cloud Computing Service and Deployment Models: Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Multi-Cloud

UNIT - II

Cloud-Enabling Technology: Cloud Data Center Technology, Modern Virtualization, Multitenant Technology, Service Technology and Service APIs, Containerization, Containers, Container Images, Multi-

Container Types. **Cloud Infrastructure Mechanisms:** Logical Network Perimeter, Virtual Server, Hypervisor, Cloud Storage Device, Cloud Usage Monitor, Resource Replication, Ready-Made Environment.

UNIT - III

Specialized Cloud Mechanisms: Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Resource Cluster, Multi-Device Broker, State Management Database **Cloud Management Mechanisms:** Remote Administration System, Resource Management System, SLA Management System, Billing Management System**.**

UNIT - IV

Cloud Computing Architectures: Workload Distribution Architecture, Elastic Resource Capacity Architecture, Multi Cloud Architecture, Hypervisor Clustering Architecture, Cloud Balancing Architecture **Specialized Cloud Architectures:** Edge Computing Architecture, Fog Computing Architecture, Meta cloud Architecture, Federated Cloud Application Architecture**.**

UNIT - V

Cloud Computing Security: Threat Agents, Common Threats, **Cloud Security and Cybersecurity Access-Oriented Mechanisms:** Cloud-Based Security Groups, Hardened Virtual Server Image, Identity and Access Management (IAM) System, **Cloud Security and Cybersecurity Data-Oriented Mechanisms:** Data Loss Prevention (DLP) System, Trusted Platform Module (TPM). **Cloud Delivery Model Considerations:** Case Study on Cloud Provider and Consumer Perspective.

Textbooks:

1. Thomas Erl, Eric Barceló Monroy, “Cloud Computing: Concepts, Technology, Security, and Architecture”, 2nd Edition, 2023, Pearson, ISBN: 9780138052287.

Suggested Reading:

1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, “Cloud Computing: Principles and Practice", 2020.
2. Comer, D, “The Cloud Computing Book: The Future of Computing Explained”, 1st edition, Chapman and Hall/CRC, 2021. https://doi.org/10.1201/9781003147503.
3. Sean Howard, “Edge Computing with Amazon Web Services: A practical guide to architecting secure edge cloud infrastructure with AWS”, 1st Edition, ISBN: 9781835081082, Packt Publishers, 2024.

22ADE63N

IMAGE AND VIDEO ANALYTICS

(Professional Elective#3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITE: NIL.

COURSE OBJECTIVES:

This course aims to:

1. To impart knowledge on the basic principles and concepts in digital image and video analytics.
2. To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Understand the requirements of image processing for computer vision and video analysis.
2. Illustrate the image pre-processing methods.
3. Develop various object detection techniques.
4. Understand the various face recognition mechanisms.
5. Elaborate on deep learning-based video analytics.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	-	-	2	2	2
CO2	-	1	1	1	-	-	-	-	-	-	-	1	1	2
CO3	2	1	1	1	-	-	-	-	-	-	-	2	1	2
CO4	2	1	1	1	-	-	-	-	-	-	-	1	1	2
CO5	-	1	1	1	-	-	-	-	-	-	-	1	1	2

UNIT - I

INTRODUCTION

Computer Vision – Image representation and image analysis tasks – Image representations–digitization, properties, color images, Data structures for Image Analysis - Levels of image data representation, Traditional and Hierarchical image data structures.

UNIT - II

IMAGE PRE-PROCESSING: Local pre-processing - Image smoothing, Edge detectors, Scale in image processing, Canny edge detection, Parametric edge models, Local pre- processing in the frequency domain, Line detection by local pre-processing operators, Image restoration.

UNIT - III

Object Detection using Machine Learning: Phasor Object detection- Object detection methods, Deep Learning framework for Object detection, Bounding box approach, Intersection over Union (IoU), Deep

Learning Architectures- R-CNN, Faster R-CNN, You Only Look Once (YOLO)-Salient features, Loss Functions, YOLO architectures.

UNIT - IV

Face Recognition and Gesture Recognition: Face Recognition- Introduction-Applications of Face Recognition, Process of Face Recognition, Deep Face solution by Facebook, Face Net for Face Recognition, Implementation using Face Net, Gesture, Recognition.

UNIT – V

Video Analytics: Video processing, use cases of video analytics, Vanishing Gradient and exploding gradient problem, Rest net architecture – Rest Net and skip connections, Inception Network, Googlenet architecture, Improvement in Inception v2,Video analytics, Rest Net and Inception v3, Python solution using Resnet and Inception v3.

TEXTBOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis and Machine Vision", 4th edition, Thamson Learning, 2013.
2. Vaibhav Verdhan, "Computer Vision Using Deep Learning" Neural Networks Architectures with Python and Keras, Apress 2021.

SUGGESTED READING:

1. Richard Szeliski, : Computer Vision:Algorithms and Applications", Springer Verlag London Limited 2011.
2. Caifeng Shan, Faith Porikli, Tao Xiang Shaogang Gong, "Video Analytics for Business Intelligence", Springer 2012.
3. D.A. Forsyth, J.Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.

WEB RESOURCES:

1. https://www.coursera.org/learn/mind-machine-computational-vision
2. https://www.javatpoint.com/computer-graphics-tutorial
3. https://www.geeksforgeeks.org/computer-vision/

22ITE10

SCALABLE WEB APPLICATION DEVELOPMENT

(Professional Elective #3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

This course aims to:

1. Understand the basic concepts of the Spring Framework
2. Provide basic knowledge of Web Application Development with Spring Boot and Restful APIs
3. Explore data access with Spring's DAO Module
4. Acquire Knowledge of Spring transaction management
5. Study Spring's unit testing framework and Introduce Spring Security with Rest API

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

1. Acquire the basic concepts of the Spring Framework
2. Interact with databases using Spring's support for JDBC and JPA.
3. Build spring boot applications using Dependency Injection concept
4. Apply Transaction Management concepts of spring in Enterprise Application Development and develop the Spring-MVC based Applications to solve the real-world problems.
5. Use Spring Unit testing framework and configure security on Spring MVC Applications

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	1	2	1	1	3	0	3
CO2	2	3	3	3	3	3	-	1	1	2	1	3	0	3
CO3	2	3	3	3	3	3	-	1	1	2	1	3	0	3
CO4	2	3	3	3	3	3	-	1	1	2	1	3	0	3
CO5	2	3	3	3	3	3	-	1	1	2	1	3	0	3

UNIT-I

Spring Overview: Introduction to Spring Framework, The DI Container, Evolution of Spring Framework.

Java Configuration: Java configuration and the Spring application context, @Configuration and @Bean annotations, @Import: working with multiple configuration files, defining bean scopes, launching a Spring Application and obtaining Beans, External properties & Property sources, Environment abstraction, Using bean profiles, Spring Expression Language (SpEL).

Annotation and Component Scanning: Component scanning, Auto wiring using @Auto wired, Java configuration versus annotations mixing Lifecycle annotations: @PostConstruct and @PreDestroy, Stereotypes and meta-annotations.

UNIT-II

Web Applications with Spring Boot: Introduction to Spring MVC and request processing, Controller method signatures, Using @Controller, @RestController and @GetMapping annotations and Configuring Spring MVC with Spring Boot.

RESful Application with Spring Boot: An introduction to the REST architectural style, Controlling HTTP response codes with @ResponseStatus, Implementing REST with Spring MVC, @RequestMapping,

@RequestBody and @Response Body, Spring MVC's Http Message Converters and automatic content negotiation and Jakson library.

UNIT-III

Spring Boot Feature Introduction:

Introduction to Spring Boot Features, Value Proposition of Spring Boot and creating a simple Boot application using Spring Initializer website**.**

Spring Boot – Dependency Management:

Dependency management using Spring Boot starters, how auto-configuration works, Configuration properties, overriding auto-configuration and Using Command Line Runner.

UNIT-IV

JDBC Simplification with Jdbc Template: How Spring integrates with existing data access technologies, Spring's Jdbc Template and Data Access Exception hierarchy.

Spring Boot – Spring Data JPA: Quick introduction to ORM with JPA, Benefits of using Spring with JPA, JPA configuration in Spring, Configuring Spring JPA using Spring Boot, Spring Data JPA dynamic repositories.

Transaction Management with Spring: Transaction overview, Transaction management with Spring, Transaction propagation and rollback rules and Transactions and integration testing.

UNIT-V

Testing a Spring-based Application: Spring and Test-Driven Development, Spring 5 integration testing with JUnit 5, Application context caching and the @DirtiesContext annotation, Profile selection with @ActiveProfiles, Easy test data setup with @Sql.

Securing REST Application with Spring Security: What problems does Spring Security solve? Configuring authentication, implementing authorization by intercepting URLs, Authorization at the Java method level, Understanding the Spring Security filter chain and spring security testing.

Actuators, Metrics and Health Indicators: Exposing Spring Boot Actuator endpoints, Custom Metrics, Health Indicators, Creating custom Health Indicators and External monitoring systems.

TEXTBOOKS:

1. Mark Heckler, "Spring Boot Up and Running, 1st Edition", Oreilly, 2021.
2. Iuliana Cosmina, Rob Harrop, Chris Schaefer, Clarence Ho, "Pro String 5", 5th Edition, Apress, 2019

SUGGESTED READING:

1. Raja CSP Raman, Ludovic Dewailly, "Building A RESTful Web Service with Spring 5", Packt Publishing, 2018.

WEB RESOURCES:

1. https://spring.io/guides/gs/spring-boot/
2. https://docs.spring.io/spring-framework/docs/current/reference/html/index.htm

22ADE64N

INTRODUCTION TO UAV SYSTEM

(Professional Elective #3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Elements of UAV System.

Course Objectives:

This course aims to:

1. Explain the locomotion principle, describe different types of mobile robots, and the basics of Unmanned Arial Vehicles (Drones) and their various applications.
2. Learn the drone's working principle and explain the components used to build the drone devices.
3. Provide hands-on experience on the design, fabrication, and flying of UAV-category aircraft.
4. Explain the rules and regulations to the specific country to fly drones.
5. Introduce safety measures to be taken during flight.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design and Develop UAV Systems: Students will be able to design and develop UAV systems, including airframes, propulsion, and control systems.
2. Understand Autopilot Systems: Students will understand autopilot systems, including navigation, control algorithms, and sensor integration.
3. Apply Sensors and Payloads: Students will be able to apply sensors and payloads, including cameras, lidar, and radar, for various UAV applications.
4. Analyze and Troubleshoot UAV Systems: Students will be able to analyze and troubleshoot UAV systems, including identifying and resolving issues with hardware, software, and communication systems.
5. Understand Safety and Regulations: Students will understand safety protocols and regulations related to UAV operation, including risk assessment and mitigation.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	2	1	1	1	-	1	1	-
CO2	2	1	1	1	-	-	-	1	1	1	-	1	1	-
CO3	2	1	1	2	-	-	2	1	1	-	-	1	1	-
CO4	1	1	1	1	1	-	-	-	1	1	-	1	-	-
CO5	1	1	1	2	-	-	-	1	1	1	-	1	1	

UNIT-I

Introduction to UAV systems**:** History and overview**,** Definition, Characteristics, differences between non autonomous Vs autonomous, Advantages and Disadvantages of UAV system, Types of vehicles, Introduction to navigation and communication.

UNIT-II

UAV overall architecture diagram; Components and functions of an UAV; Forces acting on UAV system; Physical properties and structure of the atmosphere: Aerodynamics – airfoil nomenclature, airfoil characteristics, Angle of attack, Mach number, Lift and Drag, Propulsion and airplane structures.

UNIT-III

UAV / UGV Elements: Introduction to UAV and UGV**,** DGCA Classification of UAVs; Types and Characteristics of Drones: Fixed, Multi-rotor, Flight controller Software, MAVLINK protocol.

UNIT-IV

Coordination Between several components for drone data collection, UAV Operation, UAV Regulation, Sensors and Payloads: GPS, IMU, Light Detection and Ranging (LiDAR), Imaging cameras, Classification of payload based on applications; Hyper-spectral sensors; Laser Detection and Range (LiDAR).

UNIT-V

Applications of UAV, AI Drones: Benefits of Combining AI and Drones, Applications of AI-Powered Drones, Challenges and ethical considerations, Drone Swarm Technologies and Algorithms, Case Studies Drone Swarms, IoT Drones.

TEXTBOOKS:

1. Introduction to Unmanned Aerial Vehicles, P K Garg, New Age International Publishers, New Delhi, 2021

REFERENCE:

1. Handbook of unmanned aerial vehicles, K Valavanis; George J Vachtsevanos, New York, Springer, Boston, Massachusetts: Credo Reference, 2014. 2016.
2. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal
3. DGCA RPAS Guidance Manual, Revision 3 – 2020

22ITE23

CYBER SECURITY ESSENTIALS

(Professional Elective #3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Networks, Information Security.

Course Objectives:

This course aims to:

1. Familiarize fundamental concepts, origins, and legal aspects of cybercrime.
2. Make students learn about various cyber offenses and methods employed by cybercriminals.
3. Enable students to understand the security challenges in mobile, wireless, and cloud computing environments
4. Equip students with knowledge of tools, methods, and countermeasures used to detect and prevent cyberattacks and identity theft.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the fundamental concepts and classifications of cybercrime and their legal implications.
2. Analyze various cyber offenses and the strategies used by attackers.
3. Evaluate security threats related to mobile and wireless devices in cybercrime contexts.
4. Identify tools, techniques, and methods used in executing cyberattacks.
5. Apply appropriate countermeasures to prevent phishing and identity theft.
6.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	3	-	2	-	1	-	2	-	1
CO2	2	3	2	-	2	2	-	1	-	1	2	3	2	1
CO3	2	2	3	2	2	2	1	-	-	1	-	3	2	2
CO4	2	2	2	-	3	2	-	-	-	-	2	2	3	2
CO5	2	2	3	1	3	2	1	2	-	2	-	3	2	2

UNIT - I

Introduction to Cyber Crime: Cyber Crime - Definition and Origins of the Word, Cyber-crime and Information Security, who are Cyber Criminals? Classification of Cyber Crimes. Cyber Crime and Indian ITA 2000, A Global Perspective on Cyber Crimes.

UNIT - II

Cyber Offenses: Introduction, How Criminals Plan Attacks, Social Engineering, Cyber stalking, Cybercafé and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector. Cloud Computing: Why Cloud Computing, Types of Services, Cyber Crime and Cloud Computing.

UNIT - III

Cyber Crime- Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card frauds in Mobile and Wireless Computing Era, Security Challenges posed by Mobile Devices, Registry settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/ Cell phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices Related Security Issues.

UNIT - IV

Tools and Methods used in Cybercrime: Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on wireless Networks.

UNIT – V

Phishing and Identity Theft: Phishing- Methods of Phishing, Phishing Techniques, Spear Phishing, Types of Phishing Scams, Phishing Toolkits and Spy Phishing, Phishing Countermeasures. **Identity Theft**- Personally Identifiable Information (PII), Types of Identity Theft Techniques of ID Theft, Identity Theft Countermeasures, How to Efface your Online Identity.

TEXTBOOK:

1. Sunit Belpre and Nina Godbole, ―Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives‖, Wiley India Pvt.Ltd, 2018.

REFERENCE BOOKS:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, ―Cyber Security and Cyber Laws‖, Paperback, 2018.
2. Cybersecurity Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, John Wiley & Sons, Sybex A Wiley Brand, 2018
3. Network Security Assessment, Chris McNab, Third Edition, O'Reilly Media, Inc., 2016
4. Computer security: principles and practice, William Stallings, Lawrie Brown, Second Edition, Pearson Education, 2013
5. Network Security Essentials: Applications And Standards, William Stallings, Fourth Edition, Pearson Education, 2011.

WEB RESOURCES:

1. OWASP - Open Web Application Security Project: https://owasp.org
2. NIST Cybersecurity Framework: https://www.nist.gov/cyberframework
3. SANS Institute: https://www.sans.org/
4. CIS - Center for Internet Security: https://www.cisecurity.org
5. ISACA: https://www.isaca.org

22ADE65N

SOCIAL NETWORK ANALYTICS
(Professional Elective #3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisite: Web Techn ologies, Computer Networks, Data Warehousing and Data Mining

Course Objectives:

1. Understand the concept of Social networks and related applications.
2. Learn Social network analysis software Tools and Libraries.
3. Understand social network Graphs and Community Mining Algorithms.
4. Learn visualization of social networks.
5. Analyze human behavior in social web and related communities.

Course Outcomes:

2. Design the social networks
3. Gain skills in tracking the social networks and its tools.
4. Use Open-source tools to perform social network analysis.
5. Visualize social networks and analysis.
6. Predict human behaviour in social network and related communities

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	-	-	1	1	2	1	1	3
CO2	1	1	1	2	3	1	2	-	1	2	3	2	2	3
CO3	2	2	1	3	-	2	-	-	-	-	-	1	1	2
CO4	2	2	1	3	-	2	3	-	1	-	-	1	-	2
CO5	-	1	-	-	-	2	3	1	1	1	-	1	1	3

Unit – I

Introduction to Social Network Analytics: Social Networks Perspective – Analysis of Network Data – Interpretation of Network Data – Social Network Analysis in the Social and Behavioural Sciences – Metrics in social network analysis.

Unit – II

Social Network Analysis, Software Tools and Libraries: Data Representation, network measures, Modelling and aggregating social network data, Social network analysis software Tools and Libraries.

Unit – III

Cliques, Clusters, Components and Community Mining Algorithms Applications Components and Sub graphs: Sub graphs – Ego Networks, Triads, Cliques, Hierarchical Clustering, Triads, Network Density and conflict.

Density: Egocentric and Socio centric – Digression on Absolute Density – Community structure and Density.

Centrality: Local and Global – Centralization and Graph Centres, Cliques and their intersections, Components and Citation Circles – Positions, Sets and Clusters.

Unit – IV

Visualizing Social Networks with Matrix: Matrix and node and link diagrams, Hybrid representations, cover networks, Community welfare, Collaboration networks, Co-Citation networks, Advances in Network Visualization – Elites, Communities and Influence, Applications of Social Network Analysis, Modelling and aggregating social network data- State-of-the-art in network data representation, Aggregating and reasoning with social network data.

Unit – V

Predicting Human Behaviour and Privacy Issues Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and countermeasures, Semantic-based Social Network Analysis in the sciences- Case study .

Textbook:

1. David Easley, Jon Kleinberg, *Networks, Crowds and Markets*, Cambridge Press, 2010.
2. Peter Mika, *Social Networks and the Semantic Web*, First Edition, Springer 2007.

Reference Books

1. Marshall Sponder, *Social Media Analytics: Effective Tools for Building, Interpreting and Using Metrics*, 1st Edition, McGraw Hill, 2011.
2. Guandong Xu, Yanchun Zhang and Lin Li, *Web Mining and Social Networking – Techniques and applications*, First Edition, Springer, 2011.
3. Borko Furht, *Handbook of Social Network Technologies and Applications*, 1st Edition, Springer, 2010.
4. Hansen, Derek, Ben Shneiderman, Marc Smith, *Analysing Social Media Networks with NodeXL: Insights from a Connected World*, Morgan Kaufmann, 2011.

Web Reference

1. https://www.coursera.org/course/sna
2. https://www.coursera.org/course/networks

22CSE08

USER INTERFACE AND USER EXPERIENCE DESIGN
(Professional Elective#4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamental Computer Skills, Knowledge of Web Technologies.

Course Objectives:

This course aims to:

1. Familiarize students with the fundamental principles and concepts of user interface (UI) and user experience (UX) design.
2. Equip students with the practical skills and knowledge necessary to design effective UI/UX interfaces.
3. Understand the importance of applying user-centered design methods throughout the design process.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply user-centered design principles to create interfaces that meet the needs and preferences of target users.
2. Demonstrate proficiency in designing intuitive user interfaces that are easy to navigate and understand.
3. Develop the skills to create wireframes, prototypes, and mockups using industry-standard design tools.
4. Gain an understanding of accessibility guidelines and principles, designing interfaces that are accessible to users with disabilities.
5. Identify emerging trends and technologies in UI/UX design.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	2	1
CO2	3	3	3	3	3	3	3	3	3	3	3	3	2	1
CO3	2	3	3	3	3	2	-	3	3	3	3	3	3	1
CO4	3	3	3	3	3	3	-	3	3	3	3	3	2	1
CO5	3	3	1	2	2	1	-	3	3	1	-	3	2	2

UNIT - I

Introduction to UI/UX Design: Understanding UI/UX Design: Definition and importance of UI/UX design, Difference between UI and UX, Roles and responsibilities of UI/UX designers, Overview of the design process. **User-Centered Design Principles**: Principles of user-centered design, User research methods (interviews, surveys and observations), Creating user personas and scenarios, Conducting user journey mapping exercises.

UNIT – II

Design Fundamentals: Basic principles of visual design (layout, typography, colour), Gestalt principles and their application in UI design, Applying visual hierarchy to improve user experience, Introduction to design tools (Sketch, Figma, Adobe XD) **Interaction Design**: Principles of interaction design, Designing effective navigation systems, Feedback mechanisms and user affordances Prototyping techniques for interaction design

UNIT - III

Usability and User Testing: Understanding usability principles, Nielsen's heuristics for user interface design, conducting heuristic evaluations of UI designs, Usability testing methods (moderated vs. unmoderated, remote testing) **User Testing and Feedback:** Planning and conducting usability tests, Analysing usability test results incorporating user feedback into UI design iterations, best practices for iterative design and testing cycles

UNIT - IV

Accessibility in UI/UX Design: Understanding accessibility guidelines (WCAG), Designing accessible interfaces for users with disabilities, Assistive technologies and their impact on UI/UX design. **Emotional Design and Engagement**: Principles of emotional design, creating emotionally engaging user experiences, Strategies for enhancing user engagement and retention, Case studies of emotionally successful UI/UX designs.

UNIT - V

Responsive and Mobile Design: Principles of responsive web design, Mobile-first design approach, adapting layouts and content for different screen sizes, Testing and debugging responsive designs. **Designing for Mobile Platforms**: Mobile UI design patterns and conventions, Navigation and interaction patterns for mobile apps, Challenges and best practices for designing mobile interfaces, Introduction to mobile prototyping tools (InVision, Marvel)

Textbooks:

1. Krug, S. Don’t Make Me Think, Rider publication,2006
2. Don Norman, "The Design of Everyday Things", Published by Basic Books,2013

Suggested Reading:

1. Jim K. Design Basics Index, how books,2010.
2. Lidwell, W., Holden, K. and Butler, J. Universal Principles of Design, Rockport Publishers,2010.

Online Resources:

1. User Interface Design - Course (nptel.ac.in)
2. Introduction to User Experience Design Course (Georgia Tech) | Coursera

22CSE09N

HIGH PERFORMANCE COMPUTING
(Professional Elective#4)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Architecture, Computer Networks Operating Systems

Course Objectives:

This course aims to:

1. Understand the relevance of High-performance computing, architectures and various computational models.
2. Learn basic of Open MP.
3. Learn basics of GPU.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the significance of High-Performance Computing and HPC Architecture, Systems and Technologies.
2. Apply models and methodologies for parallel programming and application development.
3. Describe the message passing interface concepts.
4. Explain the architecture of GPU and Edge Computing on SoC.
5. Describe about high performance storage technologies.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	-	-	-	1	-	-	3	2	2
CO2	2	2	3	1	1	-	-	-	1	-	-	3	3	2
CO3	2	1	1	1	1	-	-	-	1	-	-	3	3	2
CO4	2	1	2	1	1	-	-	1	1	2	-	3	3	2
CO5	2	2	-	2	1	-	-	-	1	2	1	3	2	2

UNIT – I

Introduction – High Performance Computing Disciplines, impact of supercomputing on science, society and security; anatomy of a supercomputer, compute performance, a brief history of Supercomputing.

UNIT - II

HPC Architecture, Systems and Technologies: Key properties of HPC, Architecture, Parallel architecture families, Flynn's taxonomy, enabling technology, Van Neumann sequential processors, vector and pipelining, Single instruction Multiple Data Array, Multiprocessors, Heterogeneous computer structures. **Commodity Clusters**: Hardware architecture, Programming interfaces, Software environments.

UNIT – III

Symmetric Multiprocessor Architecture: Architecture overview, Amdahl's Law Plus, Processor Core architecture, memory hierarchy, PCI Bus, external interfaces. **OpenMP**: Overview of OpenMP programming model, parallel threads and loops, synchronization, reduction.

UNIT-IV

Distributed memory parallel Programming with MPI: Message passing interface standards, MPI basics, communicators, point-to-point messages, synchronization collectives, communication collectives, non-blocking point-to-point communication, user-defined data types.

UNIT – V

Accelerator Architecture: Historic perspective, introduction to Graphics Processing Units, evolution of GPU functionality, modern GPU architecture, heterogeneous system architecture, introduction to System on Chip SoC), HPC on SoC, types of SoC, Edge Computing, High Performance on Edge devices. **Mass Storage:** Brief history of storage, storage device technology, aggregated storage, high performance storage, all flash/SSD.

Textbooks:

1. Thomas Sterling, Mathew Anderson, "High Performance Computing: Modern Systems and Practices", 1st Edition, Morgan Kaufman Publishers, 2017.

Suggested Reading:

1. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall / CRC Computational Science Series, 2011.
2. Charles Severance, Kevin Dowd, "High Performance Computing", OpenStx CNX, 2021.

Online References:

1. https://nptel.ac.in/courses/106108055.
2. https://prace-ri.eu/wp-content/uploads/Edge-Computing-An-Overview-of-Framework-and-Applications.pdf.

22ITE17

SERVERLESS COMPUTING

(Professional Elective#4)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. Introduce the Fundamentals of Serverless computing.
2. Learn Concepts of Faas and limitations of serverless computing.
3. Know the Concepts of event driven applications and Automation with Serverless.
4. Familiarize how AWS Lambda works, Execution environment and security.
5. Explore AWS lambda, its programming models and gateways, APIs, to build serverless applications.

Course Outcomes:

After completion of the course, students will be able to

1. Describe the evolution of computing and software architectures.
2. Summarize the key characteristics, benefits, and limitations of serverless computing.
3. Apply event-driven design principles to develop modern applications.
4. Demonstrate the use of AWS Lambda for building serverless applications.
5. Analyze AWS Lambda functions and deployment configurations for serverless solutions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	0	0	0	1	1	1	2	3	2
CO2	2	3	2	2	2	1	0	0	2	2	1	2	3	2
CO3	3	3	2	3	3	1	0	2	1	3	2	2	3	3
CO4	3	3	2	3	3	2	0	1	1	3	2	2	3	3
CO5	3	3	2	3	3	2	0	1	1	3	2	2	3	3

UNIT – I

Introduction: Serverless computing, The Evolution of Compute, understanding enterprise data centres, Exploring the units of compute, Understanding software architectures.

UNIT – II

Serverless and event-driven collision, Introduction to FaaS, FaaS states, benefits, Comparison with PaaS, Comparison with containers, #NoOps, Limitations of serverless computing.

UNIT – III

Event-Driven Applications, Understanding modern applications, Evolution of integration patterns, Automation with serverless.

UNIT – IV

AWS Lambda: Getting Started with AWS Lambda, How does AWS Lambda work, Execution environment, configuring options for AWS Lambda, Securing AWS Lambda using IAM.

UNIT – V

The Foundations of a Function in AWS, Fundamentals of a function, Use cases, Setting up security, Invoking Lambda functions, Anatomy of a Lambda function, The programming model, Writing your first Lambda function, Adding Amazon API Gateway, Introducing Amazon API Gateway, Serverless APIs, Securing an API, Building, deploying, and managing APIs.

Textbooks:

1. Learn AWS Serverless Computing: A beginner's guide to using AWS Lambda, Amazon API Gateway, and services from Amazon Web Services, Scott Patterson, 1st Edition, 2019, Packt Publishers.
2. Hands-On Serverless Computing: Build, run and orchestrate serverless applications using AWS Lambda, Microsoft Azure Functions, and Google Cloud Functions, Kuldeep Chowhan, 1st Edition, 2018, Packt Publishers

Suggested Reading:

1. Hands-On Serverless Computing with Google Cloud: Build, deploy, and containerize apps using Cloud Functions, Cloud Run, and cloud-native technologies, Richard Rose, 1st Edition, 2020, Packt Publishers.
2. Hands-On Serverless Applications with Kotlin: Develop scalable and cost-effective web applications using AWS Lambda and Kotlin, Hardik Trivedi, Ameya Kulkarni, 1st Edition, 2018, Packt Publishers

Web Resources:

1. https://journalofcloudcomputing.springeropen.com/articles/10.1186/s13677-021-00253-7
2. https://cacm.acm.org/magazines/2019/12/241054-the-rise-of-serverless-computing/fulltext
3. https://cloud.google.com/discover/what-is-serverless-computing
4. https://www.ibm.com/think/topics/serverless
5. https://aws.amazon.com/serverless/
6. https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-serverless-computing

22CIE07

ETHICAL HACKING
(Professional Elective#4)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites
Programming and Problem Solving, Database Management System, Web Technologies, Operating System, Computer Networks, Fundamentals of Cyber Security and Tools.

Course Objectives
1. Understand the fundamental concepts and terminologies of ethical hacking, including reconnaissance and foot printing techniques.
2. Apply scanning methodologies to identify network vulnerabilities and perform enumeration.
3. Analyse web-based and wireless network vulnerabilities to understand potential attack vectors.
4. Evaluate different penetration testing methodologies and report writing techniques.
5. Create strategies for remote exploitation and post-exploitation activities to maintain access.

Course Outcomes
By the end of this course, students should be able to:
1. Explain various information-gathering methods and tools used in ethical hacking, such as passive and active foot printing.
2. Demonstrate the use of scanning tools to identify open ports and services and perform enumeration to gather system information.
3. Assess the security weaknesses in web applications and wireless networks and identify appropriate exploitation techniques.
4. Develop a comprehensive penetration testing report, including vulnerability assessment summaries and risk evaluations.
5. Apply remote exploitation techniques, such as privilege escalation and backdoor installation, utilizing tools like MSF Venom to gain unauthorized access to target systems.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	1	-	-	1	2	3	3	2	2
CO2	3	3	3	2	2	1	-	1	1	2	2	3	3	2
CO3	3	3	3	3	2	1	-	1	-	2	2	3	3	2
CO4	3	3	3	3	2	1	-	1	-	1	3	3	2	2
CO5	3	2	2	3	3	3	2	1	1	2	3	3	3	2

Unit – I
Introduction to Ethical Hacking: Hacking Terminology, The Ethical Hacker, Reconnaissance, Information Gathering for the Ethical Hacker, Foot printing, Passive and Active Foot printing, Foot printing Methods and Tools- Search Engines, Website and E-mail Foot printing, DNS Foot printing, Network Foot printing.

Unit – II
TScanning and Enumeration: TCP/IP Networking, Subnetting, Scanning Methodology, Identifying Targets, Port Scanning, Evasion, Vulnerability Scanning, Enumeration, Sniffing, Network Knowledge for sniffing, Active and Passive Sniffing, Sniffing Tools and Techniques.

Unit – III

Web-Based Hacking: Servers and Applications, Web servers, Attacking Web Applications, Wireless Network Hacking, Wireless Networking, Wireless Terminology, Architecture, and Standards, Wireless Hacking.

Unit – IV

Penetration Testing, Categories of Penetration Test, Black Box, White Box, Fray Box, Types of Penetration Tests, Report Writing, Structure of a Penetration Testing Report, Vulnerability Assessment Summary, Risk Assessment, Methodology, Linux Basics.

Unit – V

Remote Exploitation: Attacking Network Remote Services, Common Target Protocols, and Tools of the Trade, Client-Side Exploitation, Methods, E-Mails with Malicious Attachments, Post exploitation, Acquiring Situation Awareness, Privilege Escalation, Maintaining Access, Backdoors, MSF Payload/MSF Encode, MSF Venom, Dumping the Hashes.

Textbooks:

1. "CEH Certified Ethical Hacker All-in-One Exam Guide" by Matt Walker, Fourth Edition, McGraw Hill, 2019.
2. Rafay Baloch “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2015.

Reference Books:

1. "The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy” by Patrick Engebretson, Second Edition, Syngress publications, 2013.
2. "Penetration Testing: A Hands-On Introduction to Hacking" by Georgia Weidman, No Starch Press, US, 2014.
3. "Hacking: The Art of Exploitation" by Jon Erickson, Second Edition, No Starch Press, US, 2008

Web References:

1. OWASP (Open Web Application Security Project): https://owasp.org/
2. SANS Institute: https://www.sans.org/
3. Offensive Security: https://www.offensive-security.com/

22ADE66N

DATA ENGINEERING
(Professional Elective#4)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Understand the basic concepts of data engineering and its lifecycle.
2. Learn how to design good data architectures using different technologies.
3. Explore various data sources and how data is generated in source systems.
4. Know about data storage types, data ingestion methods, and file format issues.
5. Learn how data is modeled, transformed, and served for analytics and machine learning.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the concepts, skills, and lifecycle of data engineering.
2. Identify suitable data architecture types and technologies for different scenarios.
3. Recognize various data sources and how data is generated in systems.
4. Compare different storage systems and ingestion techniques.
5. Apply data modeling and transformation methods for analytics and machine learning.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	-	-	-	3	3	3	3	3
CO2	3	3	3	3	2	3	-	-	-	3	3	3	3	3
CO3	3	3	3	3	2	2	-	-	-	3	3	3	3	3
CO4	3	3	3	3	2	2	-	-	-	3	3	3	3	3
CO5	3	3	3	3	2	3	-	-	-	3	3	3	3	3

UNIT-I

Data Engineering: What is Data Engineering, Data Engineering Skills and Activities.

Data Engineering Lifecycle: What is Data Engineering Life Cycle, The Data life cycle vs Data Engineering Life cycle, Major undercurrents across the Data Engineering Life cycle.

UNIT-II

Designing Good Data Architecture: What is Data Architecture, Principles of Good Data Architecture, Majoy Architecture Concepts, Examples and Types of Data Architecture, who is involved with designing a Data Architecture.

Choosing Technologies: Team Size and capabilities, Speed to Market, Interoperability, Cost Optimization and Business value, today vs the Future, Location, build vs Buy, Monolith Vs Modular, Serverless Vs Servers, Optimization, Performance and the Benchmark Wars.

UNIT-III

Data Generation in Source Systems: Sources of Data, Source Systems, Source system Practical details. Whom

you'll work with, Undercurrents and their impacts on Source Systems.

UNIT-IV

Storage: Raw Ingredients of Data Storage, Data storage systems, Data Engineering Storage abstractions, Big Ideas and Trends in Storage.

Ingestion: What is Data Ingestion, Key Engineering Considerations for ingestion, Batch Ingestion considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data. Practical Issues with common File Formats.

UNIT-V

Queries, Data Modeling, Transformations: Queries, Data Modelling, Transformations.

Serving Data for Analytics, Machine learning and Reverse ETL: General Considerations for serving Data, Analytics, Machine Learning, what a Data Engineer should know about ML, Ways to Serve Data for Analytics and ML, Reverse ETL.

TEXTBOOKS:

1. "Fundamentals of Data Engineering: Plan and Build Robust Data Systems" by Joe Reis and Matt Housley, O'Reilly Media, 2022.
2. Data Engineering with Apache Spark, Delta Lake, and Lakehouse, Manoj Kukreja, Danil Zburivsky, Packt Publishing Ltd, 22 Oct 2021.

SUGGESTED READING:

1. "Data Engineering with Google Cloud Platform" by Adi Wijaya, Packt Publishing, 2022.
2. "Data Engineering with Python: Work with massive datasets to design data models and automate data pipelines using Python" by Paul Crickard, Packt Publishing, 2020.
3. "Current Trends and Advances in Computer-Aided Intelligent Environmental Data Engineering" edited by Gonçalo Marques and Joshua O. Ighalo, Academic Press (Elsevier), 2022.

22BTO03

BIOTERRORISM AND NATIONAL SECURITY
(Open Elective#1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required

Course Objectives:
1. Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.
2. To provide students with an in-depth characterization of different forms of bioterrorism, agroterrorism, and surveillance.
3. To define bioterrorism and forensics, the law and bioterrorism, and to present a sociological perspective on biodefense and bioterrorism
4. To provide students with contacts with faculty members, health care providers, and industrial experts as a resource for information on biological threats.

Course Outcomes: Exposure to threats for national security, methods to tackle them and support law enforcement & health agencies to handle them.
1. Evaluate different types of bioterrorism challenges.
2. Assess various categories of agents for bioterrorism.
3. Illustrate the various aspects of bioweapon and associated case studies.
4. Apply techniques for detection of bioterrorism.
5. Summarize key national and international legal principles and sources that address bioterrorism

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	0	0	1	1	2	1	0	0	0	0	1	0	0
CO2	1	0	0	0	1	3	0	0	0	0	0	1	0	0
CO3	1	0	0	1	1	2	2	0	0	0	0	1	0	0
CO4	2	1	0	1	1	2	0	0	0	0	0	2	1	0
CO5	1	0	0	0	0	3	1	0	0	0	2	1	0	0

UNIT-I

Terrorism and Bioterrorism: Definition and Historical perspective of Bioterrorism, Traditional terrorists & New terrorists (Nuclear, chemical and radiological weapons), Agroterrorism, Bio surveillance & Bio diagnostics.

UNIT-II

Types of Bioterrorism Agents: Primary classes of Microbes-bacteria, virus, and other Agents. and their mechanism as terrorist in living systems. High-priority agents (Ebola virus), Moderate-priority agents (Brucellosis, Q fever), Low-priority agents (Yellow fever virus, Hantavirus)

UNIT-III

Bio-weapons and Techniques: Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity- Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF. Genetically Engineered Microbes

UNIT-IV

Prevention and Control of Bioterrorism: Surveillance and detection, Detection equipment and sensors, Novel Detections Methods for Bioagents, Industrialized Production of a Vaccine for a Bioagent, Biosecurity in the Food Industry

UNIT-V

Bioterrorism Management: Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control and industry Support-Microbial forensics. Role of National and International Organizations in prevention and control of bioterrorism

Textbooks:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press, 1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

Reference Books:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

22MTO01

FUNDAMENTALS OF QUANTUM COMPUTING
(Open Elective#1)

Instruction	3L Hours per week
Duration of semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn basic mathematical Concept for Quantum Computing.
2. To understand the evaluation of the quantum bits. & building blocks.
3. To know the basics of Quantum logic gates and circuits.
4. To learn Quantum Algorithms by various Techniques.
5. To introduce fundamentals of Quantum cryptography

Course Outcomes: At the end of the course, students will be able to

1. Compute basic mathematical operations on Quantum bits.
2. Solve Quantum operations.
3. Apply quantum Logical gates and circuits.
4. Implement quantum algorithm.
5. Implement Cryptography in Quantum.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	3	2	2
CO2	2	2	-	-	-	-	-	-	-	-	-	3	3	2
CO3	2	2	1	-	-	-	-	-	-	-	-	3	3	2
CO4	2	2	2	2	-	-	-	-	2	2	-	3	2	2
CO5	2	2	2	2	-	-	-	-	2	2	-	3	3	2

UNIT-I: Math Foundation for Quantum Computing:
Introduction to Vector Space, Subspaces, Linear Independent and dependent Vectors, Basis and Finite Dimensions. Orthogonality of Vectors, Inner product and Outer product of Hilbert Spaces. Unitary operators and projections, Eigenvalues and Eigenvectors. Introduction to GCD and Congruence.

UNIT-II: Introduction to Quantum Computing:
Quantum Mechanics (Huygens wave theory, Photo electric effect De-Broglie hypothesis and Heisenberg's uncertainty Principle), Origin of Quantum Computing, Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave). Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product.

UNIT-III: Quantum Logical gates and Circuits:
Single Qubit gates: Pauli, Hadamard, Phase shift, Controlled gates: C-NOT, CCNOT. Quantum Entanglement, Quantum Teleportation (EPR Model) and Bell State, Introduction to Discrete Fourier Transform.

UNIT-IV: Quantum Algorithms:

Quantum Fourier Transform, Quantum Phase estimation, Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm.

UNIT-V: **Quantum Cryptography:**

Public and private key Cryptography, Quantum key distribution, Quantum Cryptography, Experimental implementation of quantum cryptography protocols.

Textbooks:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley.

Web Resources:

1. https://archive.nptel.ac.in/courses/115/101/115101092/

22EGO01

TECHNICAL WRITING SKILLS
(Open Elective#1)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Language proficiency and the ability to simplify complex technical concepts for a diverse audience.

Course Objectives:
The course will introduce the students to:
1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:
After successful completion of the course students will be able to:
1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words.
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	2	1	1	-	1	2	3	3	2	3	2	1	2
CO2	-	1	-	1	-	-	1	2	2	1	2	1	1	1
CO3	-	2	-	2	-	1	1	2	3	2	2	2	2	2
CO4	2	2	1	3	-	2	1	3	3	2	2	2	2	2
CO5	1	1	1	1	-	1	1	3	3	2	2	2	2	2

Unit - I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.

Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.

Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.

Technical Proposals: Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

Technical Presentations: Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Textbooks:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communications-Principles and Practice", Oxford University Press, Second Edition, 2012.
2. M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading:

1. Kavita Tyagi & Padma Misra, "Basic Technical Communication", PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

22MTO02

OPTIMIZATION TECHNIQUES
(Open Elective#1)

Instruction	3L Hours per week
Duration of End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Mathematical Foundation for Data Science and Security.

Course Objectives: The objectives of this course are

1. To identify and develop optimization techniques from the verbal description of real system.
2. To learn different techniques to get optimum solution LPP.
3. To understand the Mathematical representations that is needed to solve optimization problem.
4. To analyze the results of the different real-world problems.
5. To construct network and find critical path using network scheduling techniques.

Course Outcomes: On Successful completion of this course, the student will be able to

1. Calculate the optimum values for given objective function by LPP.
2. Solve the solution for maximize the profit with minimum cost by Transportation problem.
3. Determine the optimum feasible solution for assignment and travelling salesman problems andcomputing the optimal solution for Job sequencing models.
4. Compute the optimum values for given objective function by IPP and optimal strategy for games.
5. Identify critical path using network scheduling.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	2	3	2	2
CO2	3	3	2	1	-	-	-	-	-	-	2	3	2	2
CO3	3	3	2	1	-	-	-	-	-	-	2	3	2	2
CO4	3	3	2	1	-	-	-	-	-	-	2	3	2	2
CO5	3	3	2	1	-	-	-	-	-	-	2	3	2	2

UNIT - I

Introduction to Operations Research: Basics definitions, objectives, models, application and limitations. Linear Programming (LP) - Mathematical Formulation of LP problem, Graphical Method, Some Exceptional Cases, Simplex Method - Introduction, computational procedure, artificial variables technique - big-M method and 2-phase method.

UNIT - II

Introduction, Mathematical Formulation of transportation Problem, Balanced / Unbalanced, Minimization / Maximization, Determination of the initial basic feasible solution using (i) North-West Corner Rule (ii) Least cost method & (iii) Vogel's approximation method for balanced & unbalanced transportation problems. Optimality Test & obtaining of optimal solution (Considering per unit transportation cost) using MODI method and steppingstone method.

UNIT - III

Introduction, Mathematical Formulation of Assignment Problem, Hungarian method for optimal solution, Solving unbalanced problem, Traveling salesman problem, Sequencing models, Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT - IV

Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's All-IPP Method, All IPP Algorithm, Branch and Bound Technique Game and strategies: Introduction, Game with maximin-minimax principle (Pure Strategies), Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

UNIT - V

Construction of Network – Rules & Precautions, C.P.M. & P.E.R.T. Networks, Obtaining of Critical Path, Time estimates for activities, Probability of completion of project, Determination of floats (total, free, independent).

Textbooks:

1. Kanti Swarup, P. K. Gupta, Man Mohan, "Operations Research", Sultan Chand Publications, 2010.
2. R. Pannerselvam, "Operations Research", PHI, 2nd Edition, 2016.

Suggested Reading:

1. Deb K. "Optimization for Engineering Design Algorithms and Examples", PHI, 2000.
2. Arora J. "Introduction to Optimization Design", Elsevier Academic Press, New Delhi, 2004.
3. Saravanan R. "Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press), 2006.
4. Hardley G. "Linear Programming", Narosa Book Distributors Private Ltd., 2002.

Online Resources:

Course Code	Course Name	Resource Links
22MTO02	Optimization Techniques	1. https://nptel.ac.in/courses/111105039 2. https://nptel.ac.in/courses/105108127

22MBO03

ORGANIZATIONAL BEHAVIOUR

(Open Elective#1)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To familiarize the students with the basic understanding of individual behavior and explore issues of motivation, communication, leadership, power, politics and organizational change.
2. To provide a comprehensive, up-to-date, practical knowledge base that provides an engaging introduction and concepts of organizational behavior.
3. To orient the students with real life examples that correlate the theory to actual practice from the industry.
4. To enable the students to practically implement the Organizational Behavior principles and practice in real time situations in their careers and life.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Analyze the behaviour, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
2. Assess the potential effects of organizational-level factors on organizational behaviour.
3. Critically evaluate the potential effects of motivating and leading the individuals in the Organization.
4. Analyze organizational behavioural issues in the context of groups, communication.
5. Develop strategies to deal with power, politics and conflict issues at workplace.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	1	1	-	1	1	1	1	-	1	-	-	1
CO2	-	1	-	1	1	1	1	1	1	-	1	-	-	1
CO3	1	2	1	2	1	1	1	1	1	-	1	-	1	2
CO4	-	1	1	2	1	-	1	2	1	-	1	-	1	1
CO5	-	2	1	2	-	-	2	1	1	-	1	-	1	1

UNIT – I

Introduction: Organizational Behaviour – Nature and levels of organizational behaviour – Individuals in organization – Individual differences – Personality and Ability – The Big 5 Model of personality, MBTI – Organizationally relevant personality traits. The nature of perception – characteristics of the perceiver, target and situation – perceptual problems, Attitude, Learning, IQ & EQ.

UNIT – II

Organization Structures and Culture: Concept of Organizational Structure– Types of Organizational Structure- Hierarchical organizational structure, Functional organizational structure, Horizontal organizational structure, Divisional organizational structures, Matrix organizational structure, Team-based organizational structure, Network organizational structure. Organizational culture and ethical behaviour – Understanding the dimensions of Culture, what do cultures do? Creating and sustaining culture, creating an ethical culture, managing change.

UNIT – III

Motivation and Leadership: Motivation–Concept of Motivation-Theories of Motivation- Maslow's Need-Hierarchy Theory, Herzberg's Motivation-Hygiene Theory, McGregor's Theory X and Theory Y, ERG Theory, Vroom's Expectancy Theory, Equity Theory. Leadership – Concept of Leadership, Leaders vs. Managers-Theories of Leadership- The Great Man theory of Leadership, Trait Theory of Leadership, Contingency Theory of Leadership, Situational Theory of Leadership, Behavioural Theory of Leadership, Presentation on Indian Leaders, Leadership issues in current business environment.

UNIT – IV

Group Behaviour: Concept of Groups- Stages of Group Formation- Work groups and teams, Team Building, Team Dynamics, Tuckmann model, Functional and dysfunctional traits of team development. Communication-Interpersonal Communication, organisational communication, roles, frameworks and barriers to effective communication, Transactional Analysis

UNIT – V

Power, Politics, Conflict and Negotiations: Power, Politics, Conflict and Negotiations– Sources of individual, functional and divisional Power. Organizational politics. Conflict – causes and consequences – Pondy's model of organizational conflict–conflict resolution strategies.

Textbooks:

1. Jennifer George and Gareth Jones "Understanding and Managing Organizational Behavior", Pearson Education Inc., 2021.
2. L.M. Prasad, "Organizational Behaviour", Sultan Chand & Sons; Fifth edition, 2014.
3. K. Aswathappa "Organizational behaviour", Himalaya Publishing House., 2013.

Suggested Reading:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, "Management and Organizational Behaviour", Pearson Education. Inc., Eighteenth Edition, 2018.
2. Richard Pettinger "Organizational Behaviour", Routledge, 2013.
3. John Schermerhorn, Jr. James G. Hunt and Richard N. Osborn "Organizational Behavior", 11th Edition, Wiley India, Edition. 2010.

22ADC62N

ARTIFICIAL INTELLIGENCE LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

1. To familiarize with search and game playing strategies.
2. To learn probabilistic reasoning on uncertain data.
3. To learn Problem solving with constraints
4. To learn building AI Agents
5. To build Speaking bots

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Explore AI tools and platforms to implement intelligent solutions on the cloud.
2. Design and develop intelligent agents for games and problem-solving scenarios.
3. Implement classical AI algorithms like A*, MinMax, and Alpha-Beta pruning for search and decision-making.
4. Construct and apply Bayesian networks and constraint satisfaction techniques for reasoning under uncertainty.
5. Develop AI-based applications such as puzzle solvers and speech recognizers using real-world datasets.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	-	2	-	-	-	-	-	2	2	1	3
CO2	3	3	1	-	2	-	-	-	-	-	2	2	1	3
CO3	3	3	1	-	2	-	-	-	-	-	2	2	1	3
CO4	3	3	1	-	2	-	-	-	-	-	2	2	1	3
CO5	3	3	1	-	2	-	-	-	-	-	2	2	1	3

LIST OF PROGRAMS:

1. Explore Artificial Intelligence implementation on Cloud
2. Design Intelligent Agents for Games.
3. Estimate the Number of Possible States in a Tic-Tac-Toe Game.
4. Implementation of A* Algorithm to find path
5. Demonstrate the time difference between Minmax algorithm and Alpha Beta pruning Algorithm
6. Construct a Bayesian network from a given data.
7. Demonstrate how to solve a region-colouring problem with constrains
8. Build an 8-puzzle solver
9. Build two bot to play Hex pawn against each other
10. Build a Speech Recognizer Bot

Textbook:

1. Russell, Norvig, ―Artificial Intelligence: A Modern Approach‖, Pearson Education, Third Edition, 2015
2. Antony So, William so. Zsolt Nagy ―The Applied Artificial Workshop, PACKT,1st edition 2020

Suggested Reading:

1. Saroj Kaushik, ―Artificial Intelligence‖, Cengage Learning India, 2011.
2. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, ―Markov Decision Process with Applications to Finance‖, Springer, 2011.
4. Nilsson. N., ―Artificial Intelligence: A New Synthesis‖, First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., ―A Classical Approach to Artificial Intelligence‖, Khanna Publishing House, Delhi

Web Resources:

1. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu/

22CIC25

INTERNET OF THINGS LAB

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Pre-Requisites
CAMP, Programming Basics.

Course Objectives:

1. Understand the basics of IoT.
2. Impart necessary and practical Skills using components of Internet of Things.
3. Develop skills required to build real-time IoT based projects.

Course Outcomes:

By the end of this course, students should be able to:

1. Use of various hardware and software components related to the Internet of Things.
2. Interface I/O devices, sensors to Raspberry Pi.
3. Monitoring remote systems using IoT.
4. Understand Things Speak in Real time IoT based projects.
5. Develop real life IoT based projects

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	1	-	-	1	3	3	1
CO2	1	1	1	1	1	-	-	-	-	-	1	3	3	2
CO3	1	1	1	1	-	-	-	-	-	-	1	3	3	2
CO4	1	1	1	1	1	-	-	-	1	-	1	3	3	2
CO5	1	1	1	1	1	1	1	-	1	-	1	3	3	2

LIST OF EXPERIMENTS

1. Introduction to IoT devices and perform necessary software installation.
2. Write a program to interface PIR sensor with Raspberry Pi and turn ON LED when motion is detected.
3. Write a program to interface DHT22 sensor with Raspberry Pi and display temperature and humidity readings.
4. Write a program to interface motor with Raspberry Pi. Turn ON the motor when the temperature is high.
5. (a) Write a program to interface LCD with Arduino and print temperature and humidity readings on it.
   (b)Write a program to interface LCD with Raspberry Pi and print temperature and humidity readings on it.
6. (a)Write a program to interface flame and smoke sensor with Arduino
   (b)Raspberry Pi and give an alert message when flame and smoke are detected.
7. (a) Write a program to interface Moisture/Rainfall sensor with Arduino and give an alert message.
   (b)Write a program to interface Moisture/Rainfall sensor with Raspberry Pi and give an alert message.
8. Any case study implemented using Thing speak platform

Textbook:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Reference Books

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill, 2017
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Friess, “Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, Series in Communications, 2013.

Web References:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik, JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”, Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, “What‟s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”, Electronic Design (Online), Mar. 2013.
5. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
6. F. Luo et al., "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.

22EGC03

EMPLOYABILITY SKILLS

(BE/BTech - Common to all Branches)

Instruction	2P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic Knowledge of Soft skills in the professional setting.

Course Objectives: To help the students

1. Learn the art of communication, participate in group discussions and case studies with confidence and make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: By the end of the course**,** the students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long-term goals, learn to manage time effectively and deal with stress.
4. Make the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	1	-	-	-	1	2	3	3	1	3	1	-	1
CO2	-	-	-	-	-	-	1	-	2	-	1	-	-	1
CO3	-	-	-	-	-	1	1	2	1	1	3	-	-	-
CO4	-	1	1	-	-	1	2	3	3	1	3	1	1	1
CO5	-	-	-	-	-	-	2	3	2	1	3	-	-	1

UNIT I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences- Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT.

UNIT III

Behavioral Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management-

Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Textbooks:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005.
2. Gulati and Sarvesh, "Corporate Soft Skills", New Delhi: Rupa and Co., 2006.
3. Edgar Thorpe and Showick Thorpe, "Objective English", 2nd edition, Pearson Education, 2007.
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010.
5.

Suggested Reading:

1. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004.
2. R.S. Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning", 2018.
3. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989.
4. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
		THEORY						
1.	22ADC71N	Principles of Big Data Analytics	3	-	3	40	60	3
2.		Professional Elective -5	3	-	3	40	60	3
3.		Open Elective -2	3	-	3	40	60	3
4.	22EEM01	Universal Human Values II: Understanding Harmony	1	-	-	50	-	1
		PRACTICAL						
5.	22ADC72N	Principles Big Data Analytics Lab	-	3	3	50	50	1.5
6.		Professional Elective –5 Lab	-	3	3	50	50	1.5
7.	22ADC73N	Project Part – 1	-	4	-	50	-	2
TOTAL			**10**	**10**		**370**	**280**	**15**
Clock Hours Per Week: 20								

L: Lecture **D: Drawing** **CIE – Continuous Internal Evaluation**
T: Tutorial **P: Practical** **SEE - Semester End Examination**

Professional Elective #5	Reinforcement Learning (22CAE08N)	DevOps Tools (22ITE11N)	Robotic Process Automation (22CSE23)	Blockchain Technology and Applications (22ADE74N)	Generative AI (22ADE76N)
Professional Elective #5 Lab	Reinforcement Learning Lab (22CAE09N)	DevOps Tools Lab (22ITE12N)	Robotic Process Automation lab (22CSE24)	Blockchain Technology and Applications lab (22ADE75N)	Generative AI Lab (22ADE77N)

Open Elective #2	Infrastructure for Smart Cities (22CEO01)	Intelligent Transportation Systems (22CEO05)	Fundamentals of Electrical Vehicles (22EEO07)	Principles of Design Thinking (22MEO01)	Neural Networks & Fuzzy Logic (22ECO07)

22ADC71N

PRINCIPLES OF BIG DATA ANALYTICS

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the importance of big data and role of Hadoop framework in analyzing large datasets by writing mapper and reducer for a given problem.
2. To familiarize writing queries in Pig and Hive to process big data
3. To present the latest big data frameworks and applications using Spark and Scala.
4. To discuss the concept and writing applications using SparkSQL.
5. To explore methods for extracting insights from massive datasets and Kafka streaming.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the processing of large datasets in Hadoop framework and Apply MapReduce architecture to solve real world problems.
2. Develop scripts using Pig over large datasets and query using Hive.
3. Explain the Implementation of Spark and the Scala programming.
4. Expertise in using Resilient Distributed Datasets (RDD) for creating applications in Spark and query using SparkSQL.
5. Analyses the mining methods of massive datasets and Kafka streaming.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	-	-	-	1	-	1	1	-
CO2	2	2	1	2	2	-	-	1	-	1	-	-	1	-
CO3	2	-	1	2	2	2	-	1	-	-	-	-	-	-
CO4	-	1	1	1	2	-	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	3	1	1	-	-	-	-	-

UNIT-I

Introduction to Big Data: Introduction, Big Data Enabling Technologies, Hadoop Stack for Big Data. **The Hadoop Distributed Files system:** Overview, The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems. **MapReduce:** Overview, Developing a MapReduce Application, How MapReduce works, MapReduce Types and Formats, MapReduce Features, MapReduce Examples.

UNIT-II

Pig: Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice. **Hive:** Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User- Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

UNIT-III

Parallel programming with Spark: Overview of Spark, Fundamentals of Scala and functional programming, Spark concepts - Resilient Distributed Datasets (RDD), creating RDDs, Basic Transformations, Basic Actions, Word Count example.

Spark SQL: What is SQL, Big Data and SQL: Spark SQL, Creating Data Frames, Data frames Operations.

UNIT-IV

Spark GraphX & Graph Analytics: *GraphX* : Introduction, Graphs in Machine Learning Landscape, Graph-structured data, PageRank, *Graph Analytics*: Property Graphs, Graph Operators, Distributed Graphs, GraphX Unified Analytics; *Case Study*: Flight Data Analysis using Spark GraphX.

UNIT-V

Big Data Mining: Frequent Pattern Mining, Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm. **Apache Kafka Fundamentals:** Architecture, Brokers, Topics, Partitions, Producers, Consumers, Kafka connect and Kafka Streams.

TEXTBOOKS:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”,2nd Edition, Cambridge University Press, 2014.

SUGGESTED READING:

1. Thilinagunarathne Hadoop MapReduce v2 Cookbook – 2nd Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, “Hadoop in Action”, Manning Publications Company, 2016.
3. Alex Holmes,” Hadoop in Practice”, Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
6. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018.
7. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017.
8. Viktor Gamov, "Kafka Streams in Action", 1st Edition, Manning Publications, 2018.

WEB RESOURCES:

1. http://www.planetcassandra.org/what-is-nosql
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com

22CAE08N

REINFORCEMENT LEARNING
(Professional Elective#5)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Probability and Statistics, Machine Learning, Data Structures

Course Objectives:
1. To Understand the fundamental principles of Reinforcement Learning and MDP Process
2. To Analyze Monte Carlo Methods and Temporal-Difference learning techniques.
3. Evaluate the use of Eligibility Traces in reinforcement learning through case studies

Course Outcomes: After completion of the course, students will be able to
1. Acquire the fundamental concepts of Reinforcement Learning.
2. Apply the concepts of Finite Markov Decision Process to solve the complex problems.
3. Analyze and evaluate the effectiveness of Monte Carlo methods and On/Off Policy methods
4. Analyze and apply Temporal Difference Learning for real world problems.
5. Evaluate eligibility traces and novel reinforcement learning solutions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	1	3	3	2
CO3	3	3	2	3	2	-	-	2	-	-	1	3	3	2
CO4	3	3	3	3	2	-	2	3	-	-	2	3	3	3
CO5	3	2	3	3	2	-	2	3	-	-	2	3	2	3

UNIT-I:
Introduction to Reinforcement Learning: -Examples, History of RL, Limitations, Scope, Elements of Reinforcement Learning, An n-armed bandit problem, Action-value methods, Incremental Implementation, Tracking a nonstationary problem, Optimistic initial values, Upper- Confidence-Bound Action Selection, Gradient bandits.

UNIT-II:
Finite Markov Decision Processes: The Agent-Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

UNIT-III:
Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off- Policy prediction via importance sampling, Incremental implementation, Off-policy monte carlo control

UNIT-IV:
Temporal-Difference learning: TD prediction, Advantages of TD prediction methods, Optimality of TD(0), Sarsa: On-policy TD control, Q-Learning: Off-policy TD control

UNIT-V:
Eligibility Traces: n-step TD prediction, The forward view of TD(λ),the backward view of TD(λ), Equivalences of forward and backward views, Sarsa(λ), Watkin's Q(λ), Off-policy eligibility traces using importance sampling.

Case studies: TD-Gammon, Samuel's Checkers Player.

Textbooks:

1. "Reinforcement learning: An introduction," First Edition, Sutton, Richard S., and Andrew G. Barto, MIT press 2020.
2. "Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015.

Reference Books:

1. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
2. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.
3. Alexander Zai and Brandon Brown "Deep Reinforcement Learning in Action," First Edition, Manning Publications 2020.

Online Resources:

1. https://nptel.ac.in/courses/106106143
2. https://www.coursera.org/specializations/reinforcement-learning

22ITE11N

DevOps Tools
(Professional Elective #5)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives
This course is designed to:
1. Provide a comprehensive understanding of DevOps principles and their role in modern software development.
2. Explain the importance of version control systems, with a focus on Git.
3. Explore continuous integration and continuous deployment (CI/CD) using tools like Jenkins and Maven.
4. Introduce containerization concepts through Docker.
5. Explain the automation of software deployment processes using configuration management tools.

Course Outcomes
Upon successful completion of this course, students will be able to:
1. Explain the core concepts and benefits of DevOps in software engineering.
2. Analyze the role of version control systems in collaborative development.
3. Describe the CI/CD pipeline and evaluate tools like Jenkins and Maven.
4. Illustrate the use of Docker in containerizing applications.
5. Discuss automated deployment strategies using tools such as Puppet.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	1		1	2	1	2	1	2	2
CO2	1	2	1	1	2	1		1	2	1	2	1	2	2
CO3	1	1	1	1	2	1		1	2	1	3	1	2	2
CO4	1	2	1	1	2	1		1	2	1	3	1	2	2
CO5	1	2	1	2	3	1		1	2	1	3	1	2	2

UNIT-1

Introduction to DevOps, DevOps Perspective, DevOps and Agile, Team Structure, Coordination, Barriers , The Cloud as a Platform: Features of the Cloud, DevOps Consequences of the Unique Cloud Features , Operations: Operations Services, Scrum, Kanban, and Agile.

UNIT-2

Overview GIT and its principal command lines: Installation, Configuration, Vocabulary, Git Command Lines, Understanding the GIT process and Gitlow pattern: Starting with the Git Process, isolating your code with branches, Branching Strategy with Gitlow.

UNIT-3

Continuous Integration and Continuous Delivery: Technical Requirements CI/CD principles, using a package manager in the CI/CD process, Using Jenkins for CI/CD implementation, Using GitLab CI .

UNIT-4

Containerizing your application with Docker: Installing Docker, Creating Docker file, Building and running a

container on a local machine, Pushing an Image to Docker Hub, Deploying a container to ACI with CI/CD pipeline. Using Docker for running command Line tools, Introduction to Kubernetes **Tools: Docker Compose, Docker Swar.**

UNIT-5

Getting Started with Docker Composer, deploying a Docker compose containers in ACI, Installing Kubernetes, first example of Kubernetes application of deployment, Deploying the code: The Puppet master and Puppet agents, Ansible, PalletOps, Deploying with Salt Stack, DevOps Best Practices, **Tools: Ansible, Salt stack**

TEXT BOOKS:

1. Len Bass, Ingo Weber and Liming Zhu, DevOps: A Software Architect's Perspective, Addison-Wesley, Pearson Publication, Second Edition, 2015.
2. Mikael Krief, Learning DevOps: A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins, Packt Publishing, 2022.

REFERENCE BOOKS:

1. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, Ryan Russell and Jason Southgate, Packt Publishing ,2018.
   Joakim Verona, Practical DevOps, Packt Publishing, 2018.

22CSE723

ROBOTIC PROCESS AUTOMATION

(Professional Elective #5)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: -

Course Objectives:

This course aims to:

1. Provide insights on robotic process automation (RPA) technology and its value proposition
2. Introduce different platforms for RPA
3. Learn different types of variables, control flow and data manipulation techniques
4. Familiarize with Image, Text and data Tables Automation
5. Describe various types of Exceptions and strategies to handle them.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Gain insights into Robotic Process Automation Technology
2. Acquire knowledge of RPA Platforms and components
3. Identify and understand Image, Text and Data Tables Automation
4. Understand various control techniques and OCR in RPA
5. Describe Exception Handling and Debugging techniques

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	3	2	2
CO2	2	1	1	-	2	-	-	-	1	2	-	3	3	2
CO3	2	1	1	2	2	-	-	-	1	1	-	3	3	2
CO4	2	1	1	1	2	-	-	-	1	-	-	3	3	2
CO5	2	1	-	1	1	-	-	-	-	-	-	3	3	2

UNIT– I

RPA Foundations- What is RPA - flavours of RPA- history of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills- On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code OCR-Databases-APls- Al- Cognitive Automation-Agile, Scrum, Kanban and Waterfall Devops Flowcharts.

UNIT–II

RPA Platforms- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and PIay - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step by step examples using the recorder.

UNIT–III

Sequence, Flowchart, and Control Flow-sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control Flow-Data Manipulation-Variables and Scope Collections-Arguments – Purpose and use Data table usage with examples Clipboard Management-File operation with step-by-step example CSV/Excel to data table and vice versa [with a step-by-step example).

UNIT–IV

Handling Events -Taking Control of the Controls- Finding and attaching windows- Finding the 08 control Techniques for waiting for a control- Act on controls - mouse and keyboard activities- Working with Ui Explorer- Handling events Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available How to use OCR- Avoiding typical failure points.

UNIT–V

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots Debugging techniques- Collecting crash dumps- Error reporting, Industry Use case, Future of RPA.

Text Books:

1. Tom Taulli, ―The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems‖, Apress Publishing, 2020
2. Alok Mani Tripathi, ―Learning Robotic Process Automation‖, Packt Publishing, 2018.

Suggested Reading:

1. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant, Independently Published, 1st Edition 2018.
2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, ―Introduction to Robotic Process Automation: a Primer‖, Institute of Robotic Process Automation,1st Edition 2015.
3. Srikanth Merianda,‖Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation‖, Consulting Opportunity Holdings LLC, 1st Edition, 2018

Online Resources:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

22ADE74N

BLOCKCHAIN TECHNOLOGY AND APPLICATIONS

(Professional Elective #5)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To develop a strong foundational understanding of blockchain technology and its core principles.
2. To examine the significance and operational structure of the Bitcoin ecosystem.
3. To explore Ethereum's supporting technologies, with a focus on consensus mechanisms and smart contract functionality.
4. To introduce the architecture and components of Hyperledger Fabric for enterprise blockchain solutions.
5. To familiarize students with real-world blockchain applications across diverse industry domains.

Course Outcomes:

Upon Successful Completion of This Course, Students Will Be Able To:

1. Explore the Fundamentals of Distributed Systems and Blockchain Technology.
2. Implement the Core Concepts of Bitcoin and the Consensus Mechanisms Involved in Bitcoin Mining.
3. Build the Consensus Protocols that Power the Ethereum Blockchain.
4. Examine Various Hyperledger Projects.
5. Analyse Real-World Blockchain Use Cases Across Multiple Industry Domains.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	-	-	-	-	-	1	1	2
CO2	-	1	1	1	1	1	-	1	-	-	-	-	1	-
CO3	1	-	1	2	2	-	-	-	-	-	-	1	-	3
CO4	-	-	1	1	2	1	2	-	1	-	-	-	-	2
CO5	-	-	-	-	-	2	3	1	1	2	-	-	-	-

UNIT-I

Blockchain Foundations: Overview of distributed systems, Introduction to Blockchain, Generic elements of a blockchain, Features of Blockchain, Applications of Blockchain, Hash Functions and Merkle Trees, Components of Blockchain Ecosystem, Cryptography and Consensus Algorithms; Types of Blockchain, Blockchain Platforms.

UNIT-II

Bitcoin Platform: Bitcoin definition, Keys and addresses, Public keys and Private keys in bitcoin, The transaction life cycle, The transaction structure, Bitcoin payments, Consensus mechanism in bitcoin, Wallet types, non-deterministic wallets, Deterministic wallets, Alternative Coins- Name coin, Litecoin, Zcash.

UNIT-III

Permissionless Blockchain Ethereum: Introducing Smart Contracts, Ethereum blockchain, The Ethereum stack, Ethereum virtual machine (EVM), Consensus mechanism in Ethereum, The Ethereum network, Ethereum

Development, setting up a development environment, Development tools and clients, Applications developed on Ethereum.

UNIT-IV

Permissioned Blockchain Hyperledger Fabric: Introduction to Hyperledger Fabric, Hyperledger Fabric architecture, Membership services, Hyperledger Projects- Fabric, Sawtooth Lake, Iroha , Components of the Fabric, Peers or nodes, Applications on Blockchain, Alternate Blockchains- Ripple, Corda.

UNIT-V

Blockchain for Government and Case Studies: Digital identity, land records and other kinds of record-keeping between government entities, Cross border payments, Know Your Customer (KYC), Food supplychain, Blockchain in Insurance Industry, Education, Healthcare, realestate management and Metavers.

TEXTBOOKS:

1. Imran Bashir, “Mastering Blockchain”, Second Edition, Packt Publishing, 2018
2. Melanie Swan, "Blockchain: Blueprint for a New Economy", First Edition, O'Reilly, 2018

SUGGESTED READING:

1. Andreas M. Antonopoulos, “Mastering Bitcoin Unlocking Digital Cryptocurrencies”, First Edition Apress, 2017
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to BuildSmart Contracts for Ethereum and BlockChain”, Packt Publishing, 2019.
3. Ramchandra Sharad Mangrulkar, Pallavi Vijay Chavan, “Blockchain Essentials - Core Concepts and **WEB** Implementations”, APress Publishing, 2024

RESOURCES:

1. https://andersbrownworth.com/blockchain/public-private-keys/
2. https://archive.trufflesuite.com/guides/pet-shop/
3. https://ethereum.org/en/
4. https://www.hyperledger.org/projects/fabric
5. NPTEL courses:
6. Blockchain and its Applications,
7. Blockchain Architecture Design and Use Cases

22ADE76N

GENERATIVE AI
(Professional Elective #5)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Python Programming, Deep Learning

Course Objectives:

This course aims to:

1. Introduce the fundamentals of generative modeling and deep learning.
2. Explore key architectures including VAEs, GANs, and Diffusion Models.
3. Apply TensorFlow/Keras to build generative models
4. Understand applications of generative AI in text, image, music, and multimodal domains.
5. Examine current and future trends in generative AI and its real-world impact.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand foundational concepts of generative modelling, probability theory, and Variational Autoencoders.
2. Analyze and implement various GAN architectures for generating synthetic data and images.
3. Explore and evaluate diffusion models including training, sampling, and analysis processes.
4. Apply transformer-based architectures for language modelling and fine-tune encoder/decoder models.
5. Develop effective prompting strategies to control and enhance outputs from generative language models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1			-	-	-	-	-	-	2	1	3
CO2	2	3	2	3	3	-	-	-	-	-	-	3	1	3
CO3	2	3	2	3	3	-	-	-	-	-	-	2	1	3
CO4	2	3	2	3	3	-	-	-	-	-	-	2	1	3
CO5	1	2	2	3	3	-	-	-	-	-	-	2	1	3

UNIT - I

Generative Modelling: What is Generative Modelling, Generative vs. Discriminative Models, The Rise of Generative Modelling, Generative Modelling Framework, **Core Probability Theory**: Sample Space, Probability Density Function, Parametric Modelling, Likelihood, Maximum Likelihood Estimation, **Variational Autoencoder**: Architecture, Exploring the Latent Space,

UNIT- II

Generative Adversarial network: Introduction, Deep Convolution GAN, Wasserstein GAN with Gradient Penalty (WGAN-GP), Conditional GAN (CGAN), **Advanced GAN**: Progressive GAN, StyleGAN, StyleGAN2

UNIT- III

Diffusion Models: Introduction, Denoising Diffusion Models (DDM) and its process, Diffusion Schedules, The Reverse Diffusion Process, The U-Net Denoising Model- Training, Sampling and Analysis, Stable Diffusion, DALL.E 2- Architecture, training Process, GLIDE, ImageGen

UNIT - IV

Transformers: Introduction, Architecture- Attention, Multi head Attention, Masking, Transformer Block, Encoder Based only Transformers Architectures and Fine Tuning: BERT, **Generative LLMs**: Introduction to LLMs, Decoder-only Transformers, Training LLMs, Fine-tuning LLMs, Introduction to various LLM: GPT, Falcon, LLaMA2

UNIT- V

Prompt Engineering: Introduction, Prompt Engineering Strategies, **Advanced Prompting Methods**: Chain of Thought, Problem Decomposition, Self-refinement, Ensembling, RAG and Tool Use, **Learning to Prompt:** Prompt Optimization, Soft Prompts

TEXT BOOK:

1. David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, Second Edition, O'Reilly Media, 2023.
2. Tong Xiao, Jingbo Zhu. *Foundations of Large Language Models*. arXiv:2501.09223 [cs.CL], January 16, 2025.

SUGGESTED BOOKS:

1. Joseph Babcock Raghav Bali, Generative AI with Python and Tensor flow 2, Packt Publishing Ltd. UK, 2021

WEB RESOURCES:

1. https://paperswithcode.com
2. https://huggingface.co/
3. https://arxiv.org/pdf/2501.09223

22CEO01

INFRASTRUCTURE FOR SMART CITIES
(Open Elective#2)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: To enable the students to
1. Comprehend the Necessity of Infrastructural Development for Smart Cities.
2. Illustrate the Components and Planning Aspects of a Smart City.
3. Outline Smart Transportation Systems for Smart Cities.
4. Summarize the Significance of Disaster Resilient Infrastructure in Smart Cities.
5. Review Policies and Implementation of Smart Cities at National and Global Perspectives.

Course Outcomes: At the end of the course, Student will be able to
1. Understand the necessity of infrastructural development for smart cities.
2. Illustrate the components and planning aspects of a smart city.
3. Outline smart transportation systems for smart cities.
4. Summarize the significance of disaster resilient infrastructure in smart cities.
5. Review policies and implementation of smart cities at national and global perspective.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	-	-	-	-	-	2	-	3
CO2	2	-	-	-	-	1	-	-	-	-	-	2	-	3
CO3	2	-	-	-	3	1	-	-	-	-	-	2	-	3
CO4	2	3	-	-	3	1	-	-	-	-	-	2	-	3
CO5	2	-	-	-	-	1	-	-	-	-	3	2	-	3

UNIT I

Fundamental of smart city & Infrastructure: Introduction of Smart City, Concept of smart city, Objective for smart cities. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment

UNIT II

Planning and development of Smart city Infrastructure: Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security.

UNIT III

Intelligent transport systems: Connected vehicles, autonomous vehicles, GPS, Navigation system, traffic safety management, mobility services, E-ticketing.

UNIT IV

Disaster resilient Infrastructure: Electricity, sanitation and water supply systems, fire hazard management, earthquake resilient structures, ICT tools.

UNIT V

Infrastructure Management: System and Policy for Smart city, integrated infrastructure management systems, worldwide policies for smart city, Government of India - policy for smart city, Smart cities in India, Case studies of smart cities.

Textbooks:

1. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); "Remaking the city: Social science perspective on urban design"; State University of New York Press, Albany (ISBN: 0-87395-678-8)
2. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science

References:

1. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science.
2. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines (1).pdf
3. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988 5. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ar12/preview
2. http://acl.digimat.in/nptel/courses/video/105105160/L01.html

22CEO05

INTELLIGENT TRANSPORTATION SYSTEMS

(Open Elective#2)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: To enable the students to

1. To understand the fundamentals of ITS.
2. To understand the role and application of data collection techniques in modern transportation systems.
3. To Understand the processes involved in information management and the operation of Traffic Management Centres (TMC).
4. Gain detailed knowledge of various functional areas within ITS.
5. Evaluate the implementation and impact of ITS programs in both developed and developing countries, recognizing global trends and challenges.

Course Outcomes: After successfully completing the course, the students will be able to

1. Outline the fundamental components of ITS.
2. Demonstrate the ability to identify various data collection techniques used in ITS.
3. Understand the telecommunications and information management in ITS.
4. Gain in-depth knowledge of the functional areas within ITS.
5. Evaluate the different user needs and services provided by ITS.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	1	3	-	-	-	-	2	-	3
CO2	2	2	-	-	-	1	3	-	-	-	-	2	-	3
CO3	2	2	-	-	-	1	3	-	-	-	-	2	-	3
CO4	2	2	-	-	-	1	3	-	-	-	-	2	-	3
CO5	2	-	-	-	-	1	3	-	-	-	-	2	-	3

UNIT I

Introduction to ITS: Definition of ITS and identification of ITS objectives, objectives and goals of ITS, historical background, evolution and development of ITS, benefits of ITS, economic, environmental, and social benefits.

UNIT II

ITS Data Collection Techniques: Detectors, types of detectors and their applications; Automatic Vehicle Location (AVL), technology and usage; Automatic Vehicle Identification (AVI), systems and implementation; Geographic Information Systems (GIS), role in ITS; video data collection, techniques and importance.

UNIT III

Telecommunications in ITS: Importance of telecommunications in the ITS system, role and necessity of telecommunications, information management, data collection, storage, and dissemination; Traffic Management Centers (TMC), functions and operations; vehicle – roadside communication, methods and technologies; vehicle

positioning system, GPS and other positioning technologies.

UNIT IV

ITS Functional Areas: Advanced Traffic Management Systems (ATMS) concepts and components; Advanced Traveler Information Systems (ATIS), features and benefits; Commercial Vehicle Operations (CVO) systems and management; Advanced Vehicle Control Systems (AVCS), safety and control mechanisms; Advanced Public Transportation Systems (APTS), enhancing public transport efficiency; Advanced Rural Transportation Systems (ARTS), ITS applications in rural areas.

UNIT V

ITS Applications and Global Perspective: ITS user needs and services, travel and traffic management, public transportation management, electronic payment systems, commercial vehicle operations, emergency management, advanced vehicle safety systems, information management, automated highway systems, concepts of vehicles in platoons, integration of automated highway systems, ITS programs in the world, overview of ITS implementations in developed countries, ITS in developing countries.

Textbooks:

1. Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principles and Architectures, CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

Reference Books:

1. Karl B. Schnelle, Jr. and Charles A. Brown, Air Pollution Control Technology Handbook, CRC Press, 1st Edition, 2001.
2. Air Pollution by Jeremy Colls, SPON Press, 2nd Edition, 2003.
3. Seinfeld, J.H., Pandis, S.N., Atmospheric Chemistry and Physics, John Wiley, 2006.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2. https://www.nptelvideos.com/video.php?id=1944&c=11

22EEO07

FUNDAMENTALS OF ELECTRIC VEHICLES

(Open Elective#2)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: None.

Course Objectives:

This course aims to know

1. Basics of Electric Vehicle history and components.
2. Various types of Electric Vehicles.
3. Different storage methods.

Course Outcomes:

After the completion of this course, the student will be able to

1. Understand the basics of electric vehicle and environmental impact.
2. Understand the various types of Electric Vehicles and their properties
3. Understand the functioning of BEV.
4. Understand the difference between HEV and FCEV.
5. Understand the various methods of energy storage.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	3	-	2	1	2	1	-	-	-
CO2	1	1	1	-	-	3	-	2	1	2	1	-	-	-
CO3	1	1	1	-	-	3	-	2	1	2	1	-	-	-
CO4	1	1	1	-	-	3	-	2	1	2	1	-	-	-
CO5	1	1	1	-	-	3	-	2	1	2	1	-	-	-

UNIT-I

Introduction to Electric vehicles: Present scenario of electric vehicles, Need of Electric Vehicles, Economic and Environmental impacts of using Electrical vehicles. Challenges faced by electric vehicles to replace ICE. Major requirements of electric vehicles.

UNIT-II

Types of Electric Vehicle and their challenges: Types of Electric Vehicle - Pure Electric Vehicle (PEV): Battery Electric Vehicle (BEV), Fuel Cell Electric Vehicle (FCEV), and Hybrid Electric Vehicle (HEV). Challenges of Battery Electric Vehicle, Hybrid Electric Vehicle and Fuel Cell Electric Vehicle

UNIT -III

Battery Electrical Vehicle: Components of BEV drive train, the electric propulsion subsystem - Driving - Battery pack with Battery Management System, on board charger, the auxiliary subsystem- Power steering unit, Common parts between ICE drive train and EV drive train,
Differences(modifications/parts to be removed/added) between ICE and EV drive train.

UNIT-IV

Hybrid Electrical Vehicle and Fuel Cell Electric Vehicle: Hybrid Electric vehicle (HEV) -Basic architecture of hybrid drive trains, Components of HEV drive train system. Classification of HEV: Grid -Able HEV (Plug in hybrid, Range extended). Fuel efficiency in HEV. Fuel Cell Electric Vehicle (FCEV) - Basic architecture of FCEV. Components of FCEV drive train system.

UNIT-V

Energy Storage: Battery based energy storage, Overview of batteries, Battery Parameters, Battery Charging, regenerative braking, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, and flywheels.

Text Books:

1. A.K. Babu, “Electric & Hybrid Vehicles”, Khanna Publishing House, New Delhi, 2018.
2. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, CRCPress, Second Edition, 2011.

Suggested Reading:

1. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
3. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newness, 2000.

22MEO01

PRINCIPLES OF DESIGN THINKING
(Open Elective#2)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Nil

Course Objectives: This course aims to
1. Create awareness of design thinking approaches
2. Identify a systematic approach for defining/identifying a problem
3. Create design thinking teams and conduct design thinking sessions collaboratively
4. Apply both critical thinking and design thinking in parallel to solve problems
5. Motivate to apply design thinking concepts to their real-life scenarios

Course Outcomes: After the completion of this course, the student will be able to upon completion of this course, the students are able to
1. Understand design thinking and its phases as a tool of innovation
2. Empathize on the needs of the users
3. Define the problems for stimulating ideation
4. Ideate on problems to propose solutions by working as a design thinking team
5. Prototype and test the proposed solutions focusing on local or global societal problems

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	2	2	2	2	2	3	2	2
CO2	1	1	2	1	2	2	2	1	2	2	2	3	2	2
CO3	1	1	2	2	1	2	2	1	2	2	1	3	2	2
CO4	2	1	2	2	1	2	2	1	2	2	2	3	3	2
CO5	2	1	2	2	1	2	2	1	2	2	2	3	3	2

UNIT – I

Introduction to Engineering & Thinking: Engineering for social and economic development; impact of science/engineering. Thinking and behavior; Types of thinking – Linear thinking, lateral thinking, systems thinking, design thinking.

Introduction to Design Thinking: Importance of Design Thinking & Human centric approach – Phases in design thinking process, five-stage model as iterative method, applications of design thinking in various domains.

UNIT – II

Empathize phase: Understanding the unique needs of the user, empathize with the users, steps in empathize phase, developing empathy towards people, assuming a beginner's mind-set (what? why?), steps in immersion activity, body storming; Case studies.

UNIT – III

Define phase: Define the problem and interpret the result, analysis and synthesis, Personas – Four different perspectives on Personas, steps to creating personas, problem statement, affinity diagrams, empathy mapping; Point of View – "How might we" questions, Why-how laddering; Case studies.

UNIT – IV

Ideation phase: What is ideation, need, uses, ideation methods; Brainstorming, rules for brainstorming; Mind maps, guidelines to create mind maps; Ideation games; Six Thinking Hats; Doodling, use of doodling in expressing creative ideas; Case studies.

UNIT – V

Prototyping phase: Types of prototyping, guidelines for prototyping, storytelling, characteristics of good stories, reaching users through stories, importance of prototyping in design thinking; Value proposition, guidelines to write value proposition; Case studies.

Testing phase: Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase.

Text Books:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2. Michael Luchs, Scott Swan, Abbie Griffin, Design thinking: New product development essentials from the PDMA. John Wiley & Sons, 2015.
3. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem- solving, Penguin Random House India Private Limited, 2020.

Suggested Reading:

1. Jeanne Liedtka, Andrew King, Kevin Bennett, solving problems with design thinking: Ten stories of what works. Columbia University Press, 2013.
2. Bala Ramadurai, Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Edition 1, 2020.

22ECO07

NEURAL NETWORKS AND FUZZY LOGIC

(Open Elective#2)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge on fundamentals of computing.

Course Objectives:

This course aims to:

1. Study the learning strategies of artificial neural networks and their training algorithms.
2. Acquire knowledge about associate memory and training algorithms of various associate memory networks.
3. Study the fuzzy rule base system, decision making system, different methods of defuzzification and applications of fuzzy logic.

Course Outcomes:

Upon completion of this course, students will be able to:

1. To differentiate biological system, intelligent systems and the concepts of crisp and fuzzy set theory
2. To analyze the learning strategies of Artificial Neural networks and learning rules
3. To understand training algorithms and are able to provide adequate knowledge about feed forward and feedback neural networks.
4. To design training algorithms for associative memory network for pattern recognition problems
5. To demonstrate knowledge and understanding of fuzzy system as they apply in real time systems and apply different methodologies to solve the problem related to the problem related to defuzzification.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	-	-	-	-	-	-	3	3	1
CO2	3	3	2	2	2	-	-	-	-	-	-	3	3	1
CO3	3	3	3	3	2	-	-	-	-	-	1	3	3	1
CO4	3	3	3	2	3	-	-	-	-	-	2	3	3	1
CO5	3	3	3	3	2	-	-	-	-	-	2	3	3	1

UNIT-I

Artificial Neural Networks:

Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Applications of ANN.

UNIT-II

Essentials of Artificial Neural Networks:

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning, Strategies (Supervised,

Unsupervised, Reinforcement), Learning Rules, Numerical problems, Types of Application.

UNIT-III
Supervised Learning Networks:
Perceptron Network, Perceptron Learning Rule, Architecture, Perceptron Training Algorithm, ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, Output Layer Computation, Radial Basis Function Demonstration through MATLAB-Introduction to Associate Memory Network.

UNIT-IV
Classical & Fuzzy Sets:
Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-V
Fuzzy Logic System Components:
Fuzzification, Membership value assignment, development of rule base and decision-making system, Defuzzification to crisp sets, Defuzzification methods, Applications.

Text Books:

1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekaran and Pai – PHI Publications.
3. Fundamental of Artificial Neural Network and Fuzzy Logic-by Rajesh Kumar, Lakshmi publications

Reference Books:

1. Neural Networks – James A Freeman and Davis Skapura, Pearson Education.
2. Neural Networks – Simon Hakins, Pearson Education

Suggested Videos:

1. https://onlinecourses.nptel.ac.in/noc21_ge07/preview#:~:text=This%20course%20will%20start%20with,help%20of%20some%20numerical%20examples.

22EEM01

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

(**B.E/B. Tech** - Common to all Branches)

Instruction	1T Hours per week
Duration of SEE	----
SEE	----
CIE	50 Marks
Credits	1

INTRODUCTION:

This course discusses the role of human values in one's family, in society and in nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives: This course aims to

1. Understand the concept of universal human values
2. Cultivate empathy and respect for diversity
3. Inspire the social responsibility and global citizenship

Course Outcomes: After the completion of this course, the student will be able to

1. Become familiar about themselves, and their surroundings (family, society, nature).
2. Develop empathy and respect for diversity by gaining an appreciation for different cultures, perspectives, and identities
3. Exhibit responsible and ethical behaviour by adhering to principles of integrity, honesty, compassion, and justice.
4. Recognize their role as global citizens.
5. Exhibit a sense of social responsibility.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	-	1	-	-	1	3	1	2
CO2	-	-	1	-	-	1	-	1	-	1	1	3	1	2
CO3	--	-	-	-	-	1	-	-	1	-	-	3	1	2
CO4	-	-	-	-	-	1	1	-	-	-	-	3	-	2
CO5	-	-	-	-	-	1	1	-	-	-	-	3	-	2

MODULE -1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and
- Experiential Validation- as the process for self-exploration.
- Natural acceptance of human values.
- Definitiveness of Ethical Human Conduct.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE- 2: Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE-3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
- Understanding the meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- Strategy for transition from the present state to Universal Human Order:
  a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers.
  b. At the level of society: as mutually enriching institutions and organizations.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.

MODULE -4: Understanding Harmony in Nature and Existence - Whole existence as Coexistence.

- Understanding the harmony in Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
- Holistic perception of harmony at all levels of existence.
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability Identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability Identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

MODE OF CONDUCT (L-T-P-C 0-1-0-0)

- While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection, and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentors, in a group sitting.
- **Tutorials (experiments or practical) are important for this course**. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to the development of commitment, namely behaving and working based on basic human values.
- **It is advised to share the experience of the faculty to the class in a capsule form.**
- **Involve more in evaluating the student by different activities with proper RUBRCCS**

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

EXAMPLE:

Module-1:	10 M
Module -2:	10 M
Module- 3:	10 M
Module-4:	10 M
Attendance & Attitude:	10 M

The overall pass percentage is 50%. In case the student fails, he/she must repeat the course.

TEXTBOOKS

1. "A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.
2. "Teacher's Manual for A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.

REFERENCE BOOKS

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi

22ADC72N PRINCIPLES BIG DATA ANALYTICS LAB

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

1. To provide the knowledge to set up a Hadoop Cluster and implement applications using MapReduce.
2. To introduce Pig, Pig Latin and HiveQL to process big data.
3. To get familiarized with the latest big data frameworks and writing applications using Spark and Scala.
4. To learn querying large datasets with Spark SQL.
5. To gain knowledge to work with the massive datasets through Clustering and Kafka streaming.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend Hadoop working environment and develop applications using MapReduce framework.
2. Develop scripts using Pig to solve real world problems and query the datasets using Hive.
3. Develop applications in Spark environment using RDDs.
4. Develop queries real-time data using Spark SQL.
5. Demonstrate the Kafka streaming.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	-	-	-	1	1	-
CO2	2	1	1	2	2	-	-	-	-	-	-	-	1	-
CO3	2	1	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	1	-	-	-	-	-	-	-	-	-	-

LIST OF PROGRAMS:

1. Demonstrate the following using HDFS
   i. Basic HDFS commands
   ii. Working with Hadoop file system: Reading, Writing and Copying
2. Develop the following applications using MapReduce
   i. Word count application using Map Reduce on single node cluster
   ii. Analysis of Weather Dataset on Multi node Cluster using Hadoop
   iii. Real world case studies on Map Reduce applications
3. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig

4. Working with Hive on the following
    i. HiveQL
    ii. Writing User Defined Functions in Hive
5. Implement the following on Spark
    i. Processing large datasets on Spark framework
    ii. Word count application
6. Implement streaming using Kafka.

TEXT BOOKS:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”,2nd Edition, Cambridge University Press, 2014.

SUGGESTED READING:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. Vignesh Prajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.

WEB RESOURCES:

1. https://parthgoelblog.wordpress.com/tag/hadoop-installation
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture

22CAE09N

REINFORCEMENT LEARNING LAB
(Professional Elective#5 Lab)

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Pre-requisites: - Probability & Statistics, Data Structures and Algorithms, Machine Learning

Course Objectives: -
1. Understand and implement fundamental concepts of Reinforcement Learning algorithms
2. Apply the concepts of Finite MDP and Monte Carlo Methods
3. Analyse TD learning and evaluate Eligibility traces using case studies.

Course Outcomes: -
Upon successful completion of the lab, the students will be able to:-
1. Understand and implement basic concepts of reinforcement learning
2. Design and implement MDP using value and policy iterations
3. Analyse and implement Monte Carlo Methods and TD learning algorithms
4. Apply and evaluate eligibility traces using case studies
5. Develop and implement RL algorithms to solve complex real-world problems

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	1	1	-	-	1	-	2	1	-
CO2	3	3	3	2	3	2	1	-	-	1	-	3	2	-
CO3	3	3	2	2	3	1	-	-	-	1	-	3	2	1
CO4	3	2	2	2	2	1	-	-	-	1	-	2	2	2
CO5	3	3	3	3	3	2	1	1	2	2	1	3	3	3

List of Experiments: -
1. Write a program to implement n-armed bandit problem, where different actions have unknown reward probabilities.
2. Write a program to implement value iteration and policy iteration algorithms for solving MDPs by using a simple grid world environment.
3. Write a program to implement the Monte Carlo Prediction Algorithms to estimate the value function for a given policy by applying on any simple environment.
4. Write a program to implement the Q-Learning Algorithm to find an optimal policy for navigating the grid with different learning rates and exploration strategies.
5. Write a program to implement the SARSA Algorithm for on-policy control in a grid or maze environment and compare its performance with Q-learning.
6. Write a program to implement the reinforcement-learning agent to play backgammon, similar to famous TD-Gammon Program.
7. Write a program that uses reinforcement learning to solve job-shop scheduling problems.

8. Write a program that visualizes the eligibility Traces for different values of λ. Observe how the eligibility traces affect the learning in TD (λ) algorithms.
9. Design and develop reinforcement learning program that implement Samuel's Checkers Player.
10. Implement TD (0), SARSA and Q-Learning Algorithms on a simple grid World environment and allow users to compare their performance, Convergence rates and explore the trade-offs between On-policy and Off-Policy Learning.

Textbooks:

1. "Reinforcement Learning: An Introduction, "First Edition, Sutton, Richard S., and Andrew G, Barto, MIT Press 2020".
2. "Statistical reinforcement learning: modern machine learning approaches," First Edition, Sugiyama, Masashi. CRC Press 2015.

Suggestive Books:

1. Practical Deep Reinforcement Learning with Python, Ivan Gridin, BPB Publications.
2. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
3. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.

Online Resources:

1. https://nptel.ac.in/courses/106106143
2. https://www.coursera.org/specializations/reinforcement-learning

22ITE12N

Devops Tools Lab
(Professional Elective#5 Lab)

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives
The objective of this lab is to:
1. Understand the fundamentals of DevOps in the context of software development.
2. Learn version control using Git for efficient code management.
3. Build, test, and deploy applications using Jenkins and Maven.
4. Utilize Docker for containerization of applications.
5. Develop and manage an end-to-end software deployment process.

Course Outcomes
Upon successful completion of this course, students will be able to:
1. Apply DevOps principles to streamline software development and delivery.
2. Use version control tools such as Git for collaborative coding and tracking changes.
3. Implement continuous integration and delivery using Jenkins and Maven.
4. Demonstrate containerization techniques using Docker.
5. Describe and execute deployment processes using automation tools like Puppet.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	3	3	3	1		1	2	1	2	1	2	2
CO2	1	1	3	3	3	1		1	2	1	2	1	2	2
CO3	1	1	3	3	3	1		1	2	1	3	1	2	2
CO4	1	1	3	3	3	1		1	2	1	3	1	2	2
CO5	1	1	3	3	3	1		1	2	1	3	1	2	2

List of Experiments:

1. To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2. Explore the Version Control System tools for Source Code Management.,
3. Install GIT and create a GitHub account and execute various GIT operations.
4. Installing and configuring Jenkins to set up a build job will help you comprehend continuous integration.
5. To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
6. To understand Docker Architecture and Container Life Cycle, install Docker and execute docker comma

to manage images and interact with containers.

7. To learn Docker file instructions, build an image for a sample web application using Docker fill.

8. Deploy a containerized application on Kubernetes cluster

9. 9. To install and Configure Pull Based Software Configuration Management and provisioning tools using Puppet.

10. 10. To learn Software Configuration Management and provisioning using Puppet Blocks (Manifest, Modules, Classes, Function)

TEXTBOOKS:

1. Len Bass, Ingo Weber and Liming Zhu, DevOps: A Software Architect's Perspective, Addison-Wesley, Pearson Publication, Second Edition, 2015.
2. Mikael Krief, Learning DevOps: A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins, Packt Publishing, 2022.

REFERENCE BOOKS:

1. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, Ryan Russell and Jason Southgate, Packt Publishing ,2018.
2. Joakim Verona, Practical DevOps, Packt Publishing, 2018.

22CSE24

ROBOTIC PROCESS AUTOMATION LAB
(Professional Elective #5 Lab)

Instruction	3P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:
This course aims to:
1. Understand and apply the foundational concepts of RPA in practical scenarios.
2. Effectively use RPA platforms for creating and managing automation tasks.
3. Develop skills in sequencing workflows and using various control flows and data manipulation techniques.
4. Develop expertise in interacting with and automating user interface elements.
5. Handle exceptions and debug RPA workflows effectively.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Apply the basic concepts of RPA to real-world problems.
2. Utilize RPA platforms to build and manage automation tasks.
3. Create workflows using sequences, control flows, and data manipulation techniques.
4. Explain interactions with user interface elements.
5. Solve issues related to exceptions and debug RPA workflows.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	3	3	2
CO2	-	-	-	1	2	-	-	-	-	-	-	3	3	2
CO3	2	1	1	-	-	-	-	-	-	-	-	3	3	2
CO4	1	-	1	-	2	-	-	-	-	-	-	3	3	2
CO5	-	1	-	1	-	-	-	-	-	-	-	3	3	2

List of Experiments:
1. Identify and utilize various components of an RPA platform to automate a simple task.
2. Implement basic operations on different data types.
3. Create a bot to perform Desktop and Gmail Login Steps using Web Recoding.
4. Create a bot to perform email automation, which can ready emails to extract pdf attachments.
5. Create an automation project that uses control flow, loops, and decision-making activities.
6. Create a bot to read pdf and performing OCR and then entering the extracted data into an excel.
7. Implement clipboard management tasks to automate copying and pasting data between applications.
8. Automate file operations, such as reading from and writing to CSV/Excel files, and converting data tables.
9. Create an automation workflow that performs mouse and keyboard activities on different controls.
10. Create an RPA workflow that demonstrates common exceptions and their handling techniques.

Textbooks:

1. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, 2020, lSBN-13 (electronic):978-7-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, “Learning Robotic Process Automation”, Publisher: Packet Publishing Release Date: March 2018 ISBN: 9787788470940

Suggested Reading:

1. Frank Casale, Rebecca Dilla, Iieidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, “Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant”
3. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”

Online Resources:

1. Learning Robotic Process Automation, https://www.packtpub.com/in/business/learning-robotic- process-automation
2. Automation Anywhere University, https://university.automationanywhere.com/
3. https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation-anywhere/11461411
4. www.uipath.com/rpa/robotic-process-automation
5. https://www.coursera.org/specializations/roboticprocessautomation

22ADE75N

BLOCKCHAIN TECHNOLOGY AND APPLICATIONS LAB

(Professional Elective #5 Lab)

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims to:

1. Understand the core principles of Blockchain Technology.
2. Explore the role of Ethereum in the blockchain ecosystem.
3. Introduce the basics of Solidity Programming used for developing blockchain applications.
4. Explore the development Environment used for smart contract development.
5. Examine the Key Features of Hyperledger Fabric.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Explore the working of blockchain fundamentals such as cryptography and distributed computing.
2. Implement smart contract on the Ethereum blockchain.
3. Build smart contracts using Solidity programming language.
4. Develop a DApp using smart contracts.
5. Analyze Hyperledger fabric.

CO-PO Articulation Matrix:

List of Experiments:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	-	-	-	-	-	1	1	2
CO2	-	1	1	1	1	1	-	1	-	-	-	-	1	-
CO3	-	2	1	2	2	-	-	-	-	-	-	1	-	3
CO4	-	1	2	1	2	1	2	-	1	-	-	-	-	2
CO5	2	-	2	-	-	2	3	1	1	2	-	-	-	-

1. Learn the functionality and use cases of Remix IDE, Truffle, and Ganache for Ethereum smart contract development.
2. Create a Crypto-currency Wallet.
3. Connect to the Public/Test net Ethereum Blockchain network using popular wallets (MetaMask or Brave browser) and understand various terminologies like gas, gas fee, gas price, priority fee.
4. Write a Solidity smart contract that stores a number and allows anyone to update it.
5. Create a Solidity program to facilitate Ether transfers between MetaMask accounts using a smart contract.
6. Develop a Full-fledged DApp using Ethereum/Hyperledger.
7. Explore a live demo showcasing the architecture, functionality, and enterprise capabilities of Hyperledger Fabric

Textbooks:

1. Imran Bashir “Mastering Blockchain”, Second Edition, Packt Publishers, 2018.
2. Melanie Swan, "Blockchain: Blueprint for a New Economy", First Edition O'Reilly, 2018.

Suggested Reading:

1. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, st Edition, Apress, 2017.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing, 2019.
3. Mackay Hazel, “Python Programming Handbook for Blockchain Technology Development: A Complete Beginners Guide to Learning Essential Skills to Build Secure Smart Contracts and Decentralized Applications with web3.py”, Independently Published, 2024.

Web Resources:

1. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
2. https://www.hyperledger.org/projects/fabric
3. https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger
4. https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523

22ADE77N

GENERATIVE AI LAB
(Professional Elective#5 Lab)

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:
This course aims to:
1. Understand the fundamental concepts of generative AI models including, GANs, and transformers.
2. Gain proficiency in implementing generative AI models using TensorFlow or PyTorch.
3. Learn to evaluate and interpret the performance of generative AI models effectively.
4. Explore real-world applications of generative AI across various domains such as image generation and natural language processing.
5. Enhance problem-solving skills by experimenting with different model architectures and datasets in generative AI tasks.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Design and implement generative models like GANs, VAEs, and U-Net for image synthesis.
2. Apply and evaluate style transfer and diffusion models for high-quality image generation.
3. Fine-tune transformer models like BERT and GPT-2 for diverse natural language processing tasks.
4. Develop intelligent applications using OpenAI APIs and Lang Chain for retrieval-augmented generation.
5. Explore zero-shot and few-shot learning using advanced prompt engineering techniques for LLMs.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	-	-	-	-	-	-	3	3	3
CO2	2	3	2	3	3	-	-	-	-	-	-	3	3	3
CO3	2	3	2	3	3	-	-	-	-	-	-	3	3	3
CO4	2	3	2	3	3	-	-	-	-	-	-	3	3	3
CO5	2	3	2	3	3	-	-	-	-	-	-	3	3	3

LIST OF PROGRAMS:
1. Implement DCGAN and train it on any dataset for image generation.
2. Analyse the performance of WPGAN- GP with vanilla GAN and VAE on any dataset for image generation.
3. Implement a style transfer algorithm using GANs and apply it to images from the CIFAR-10 dataset
4. Implement a basic Unet-based denoising model for image restoration.
5. Use Hugging Face Diffusers library to generate images using Stable Diffusion
6. Analyse the performance output quality of Stable Diffusion vs DALL·E 2
7. Fine tune BERT Transformer for various NLP tasks.
8. Use decoder-only models like GPT-2 for text generation.

9. Utilize the OpenAI API to build a question-answering application powered by GPT-3, allowing users to input questions and receive relevant answers.
10. Explore zero-shot and few-shot learning with OpenAI GPT via API.
11. Perform prompt optimization using Open Prompt or Prompt Source.
12. Use RAG (Retrieval-Augmented Generation) with LLMs using Lang Chain.

SUGGESTED BOOKS:

1. Steve Tingiris Exploring GPT-3, Packt Publishing Ltd. Uk, 2021
2. Joseph Babcock Raghav Bali, Generative AI with Python and Tensor flow 2, Packt Publishing Ltd. UK, 2021
3. Sabit Ekin, Prompt Engineering for Chat GPT: A Quick Guide to Techniques, Tips, and Best Practices, DOI: 10.36227/tech arxiv.22683919.v2, 2023
4. Foster, D. "Generative Deep Learning. Teaching Machines to Paint, Write, Compose and Play (2019)." Beijing-Boston-Farnham-Sebastopol-Tokyo, OREILLY (2019): 330.
5. Hany, John, and Greg Walters. Hands-On Generative Adversarial Networks with PyTorch

22ADC73N **PROJECT PART–I**

Instruction	4 Hours per week
Duration of SEE	--
SEE	--
CIE50 Marks	
Credits	2

Prerequisite: Knowledge of core engineering courses, Capable of searching for suitable literature, Problem Identification and Solving.

Course Objectives:

1. The student takes up investigative study in the broad field of Engineering / Technology, involving both theoretical and practical knowledge.
2. Motivate student(s) towards Research & Development with creative problem solving.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Examine and interpret relevant literature to identify significant problems in their field of interest.
2. Summarize and synthesize key findings from the literature related to the identified problem.
3. Critically evaluate existing solutions to the identified problem based on literature findings.
4. Design a novel solution to the identified problem using insights gained from the literature survey.
5. Formulate and deliver clear and coherent oral presentations and written reports to effectively communicate the research process and findings.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	1	3	1	1	3	2	3
CO2	3	3	2	3	1	1	1	1	3	1	1	3	3	2
CO3	3	3	3	1	1	1	1	1	3	1	1	2	2	3
CO4	3	3	3	3	3	1	2	1	3	1	2	3	3	2
CO5	3	1	1	1	1	1	1	3	3	3	1	2	2	3

The work shall include:

1. Survey and study of published literature on the assigned topic
2. Preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a Departmental Research Committee.

Guidelines for the award of 50 Marks

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	5	Regularity and Punctuality
	5	Work Progress
	5	Quality of the work
	5	Report on Project Part-1
Project Coordinator	5	Technical Content
	5	Presentation
	5	Partial Implementation
Department Review Committee	10	Project Review
	5	Conference/Journal Publication

Note:

Students are instructed to

1. Prepare an Action Plan with project work timelines.
2. Submit weekly project status reports duly signed by the supervisor.
3. Prepare a report in the specified format.
4. Present project seminars as per schedules

Write a Survey paper for Conference presentation/ Publication in Journals.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

DEPATMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(In line with AICTE Model Curriculum with effect from AY 2024-25)

SEMESTER – VIII

S.No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Professional Elective – 6	3	-	3	40	60	3
2		Open Elective – 3	3	-	3	40	60	3
PRACTICAL								
3.	22ADC81N	Technical Seminar	-	2	-	50	-	1
4.	22ADC82N	Project Part -II	08 Hours per week /180 Hours Industry -			100	100	4
TOTAL			**06**	**02**		**230**	**220**	**11**
Clock Hours Per Week: 08								

L: Lecture **D: Drawing** **CIE – Continuous Internal Evaluation**
T: Tutorial **P: Practica** **SEE - Semester End Examination**

Professional Elective #6	Explainable AI (22ADE83N)	ML Ops (22ADE84N)	Healthcare Analytics (22ADE85N)	AI and Cyber Forensics (22ADE86N)	Immersive Technologies (22CIE24)

Open Elective #3	Engineering Leadership (22MBO04)	Introduction to Operations Research (22MEO04)	Research Methodologies and Innovation (22MEO05)	Strategic Entrepreneurship (22MBO02)	Indian Traditional Knowledge (22EGO03)

22ADE83N

EXPLAINABLE ARTIFICIAL INTELLIGENCE (XAI)

(Professional Elective#6)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite:

1. Fundamentals of Probability & statistics
2. Machine Learning and Deep Learning basics

Course Objectives:

This course aims to:

1. Understand the need for Explainable Artificial Intelligence (XAI) in engineering applications and its central concepts.
2. Impart knowledge on mathematical concepts like ensemble models and nonlinear models to analyze the problems.
3. Illustrate tools and techniques of XAI for design and building solutions.
4. Evaluate common Explainable AI methods.
5. Explore evaluation methods and metrics, ethical, legal, and social issues, and applications and examples of XAI.

Course Outcomes:

After completion of the course, students will be able to

1. Understand the fundamental concepts and types of Explainable AI (XAI), and evaluate methods for bias and reliability using SHAP, LIME, and Skater.
2. Apply SHAP, LIME, and Skater to interpret predictions of linear models and enhance trust in model outcomes.
3. Utilize SHAP, PDP, LIME, or Skope-Rules to interpret non-linear model behavior and decision-making processes effectively.
4. Apply SHAP to ensemble models to understand the contributions of individual models within the ensemble and explain model predictions.
5. Analyze fairness and transparency in AI models using Counterfactual Explanation (CFE) concepts.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	2	2	-	-	-	-	-	-	1	1	-	2
CO 2	-	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO 3	2	1	1	1	-	-	-	-	-	-	-	1	1	-	2
CO 4	1	1	1	1	-	-	-	-	-	-	-	1	1	-	1
CO 5	-	1	1	1	-	-	-	-	-	-	-	1	1	-	-

UNIT – I

Introduction to Explainable Artificial Intelligence: Artificial Intelligence, Need for XAI, Explainability vs. Interpretability, Explainability Types**, Tools for Model Explainability:** SHAP, LIME, Skater, Skope_rules.

Methods of XAI for ML, XAI Compatible Models, XAI Meets Responsible AI, Evaluation of XAI, Biasness, and Reliability.

UNIT – II

Explainability for Linear Models: Linear Models, Linear Regression. **VIF and the Problems It Can Generate**: Final Model, Model Explainability. **Trust in ML Model:** SHAP - Local Explanation and Individual Predictions in a ML Model, Global Explanation and Overall Predictions in ML Model, LIME Explanation and ML Model, Skater, Explanation and ML Model, Logistic Regression: Interpretation, LIME Inference.

UNIT – III

Explainability for Non-Linear Models Non-Linear Models, Decision Tree Explanation, **Data Preparation for the Decision Tree Model**: Creating the Model, Decision Tree – SHAP, Partial Dependency Plot, PDP Using Scikit-Learn, Non-Linear Model Explanation – LIME, Non-Linear Explanation – Skope-Rules

UNIT – IV

Explainability for Ensemble Models: Types of Ensemble Models, Why Ensemble Models, Using SHAP for Ensemble Models, Using the Interpret Explaining, Boosting Model, **Ensemble Classification Model:** SHAP, Using SHAP to Explain Categorical Boosting Models, Using SHAP Multiclass Categorical Boosting Model, Using SHAP for Light GBM Model Explanation

UNIT – V

Counterfactual Explanations for XAI Models: AI Model Fairness Using a What-If Scenario: WIT (Google Tool), Evaluation Metric. **Counterfactual Explanations for XAI Models:** What Are CFEs, Implementation of CFEs, CFEs Using Alibi, Counterfactual for Regression Tasks.

Textbooks:

1. Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks, Pradeepta Mishra, 2020, Apress Publishers.
2. Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps, Denis Rothman, 1st Edition, 2020. Packt Publishers

Suggested Reading:

1. Explainable AI: Interpreting Machine Learning with XAI, Knime, Keerthan Shetty & Paolo Tamagnini
2. Explainable AI: Foundations, Methodologies and Applications, Mayuri Mehta, Vasile Palade, Indranath Chatterjee, Springer.

Web Resources:

1. https://cloud.google.com/explainable-ai/
2. https://interpretable-ml-class.github.io/
3. https://www.coursera.org/projects/scene-classification-gradcam
4. https://dl.acm.org/doi/book/10.1007/978-3-030-28954-6
5. https://alison.com/course/explainable-ai-explained

22ADE84N

ML Ops

(Professional Elective#6)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite:

- Machine Learning.
- Introduction to DevOps and Microservices.

Course Objectives:

This course aims to:

1. To divulge knowledge on how to scale machine learning in the enterprise
2. To provide comprehension of various activities involved in the development, deployment, and monitoring of ML models
3. To disseminate the basic principles of MLOps.

Course Outcomes:

The students are expected to have the ability to:

1. Understand the novel techniques on how to scale machine learning in the enterprise.
2. Identify key metrics to optimize model performance.
3. Understand the various deployment options.
4. Apply best practices for data management and governance in enterprise ML systems.
5. Collaborate effectively with cross-functional teams throughout the ML lifecycle.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	2	2	-	-	-	-	-	-	2	2	2	2
CO 2	-	1	1	1	-	-	-	-	-	-	-	1	1	2	-
CO 3	2	1	1	1	-	-	-	-	-	-	-	2	1	2	2
CO 4	2	1	1	1	-	-	-	-	-	-	-	1	1	2	2
CO 5	-	1	1	1	-	-	-	-	-	-	-	1	1	2	-

UNIT - I

INTRODUCTION

Introduction, Defining MLOps and Its Challenges, Difference between MLOps and DevOps. MLOps to Mitigate Risk. MLOps for scale. People of MLL Ops- Subject Matter Experts, Data Scientists, Data Engineers, Software Engineers, DevOps, Model Risk Auditor and Architect.

UNIT - II

Key MLOps Features-Model Development, Productionalization and Deployment, Monitoring, iteration and Governance, Developing Models. **Developing Models-** What Is a Machine Learning Model?, Data Exploration, Feature Engineering and Selection, Experimentation, Evaluating and Comparing Models, Version Management and Reproducibility.

UNIT – III

Preparing for Production- Runtime Environments, Model Risk Evaluation and Mitigation, Machine Learning Security**. Deploying to Production-** CI/CD Pipelines, Building ML Artifacts, Deployment Strategies, Scaling Deployments.

UNIT – IV

Monitoring and Feedback Loop- Understanding Model Degradation- Ground Truth Evaluation, Input Drift Detection, Drift Detection in Practice-Example Causes of Data Drift and Drift Detection Techniques, The Feedback Loop.

UNIT – V

Model Governance-Matching Governance with Risk Level, The New Wave of AI-Specific Regulations, The Emergence of Responsible AI, Key Elements of Responsible AI, A Template for MLOps Governance, MLOps: Real-World Examples.

Textbooks:

1. Treveil, Mark, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, and Lynn Heidmann. Introducing MLOps. O'Reilly Media, 2020.
2. Burkov, Andriy. Machine Learning Engineering. True Positive Inc., 2020

Suggested Reading:

1. Ameisen, Emmanuel. Building Machine Learning Powered Applications. O'Reilly Media, 2020.
2. ML Ops: Operationalizing Data Science by David Sweenor, Dev Kannabiran, Thomas Hill, Steven Hillion, Dan Rope and Michael O'Connell-O'Reilly.
3. Operationalizing Data Science by David Sweenor, Dev Kannabiran, Thomas Hill, Steven Hillion, Dan Rope and Michael O'Connell-O'Reilly

22ADE85N

HEALTHCAREANALYTICS

(Professional Elective#6)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites

Basic understanding of statistics and probability, Python, Data Mining, Machine Learning.

Course Objectives

1. Learn about different types of healthcare data and how to prepare and analyse them.
2. Understand body signals and genetic data to improve healthcare.
3. Use text data like doctor notes and reports to find useful information.
4. Make prediction models and learn how to keep patient data safe.
5. Explore real-world tools that help with diagnosis, treatment, and patient care.

Course Outcomes

By the end of this course, students should be able to:

1. Understand different types of healthcare data and use basic analysis methods
2. Analyse biomedical signal and genomic data using appropriate statistical methods.
3. Apply NLP and information retrieval techniques to extract knowledge from unstructured healthcare data.
4. Develop predictive models and visualize healthcare data while ensuring data privacy.
5. Evaluate practical healthcare systems and propose data-driven applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	1	-	1	-	-	1	-	-	1	1	-	2
CO 2	2	1	1	1	-	1	-	-	1	-	1	2	1	-	2
CO 3	2	1	-	1	2	1	-	-	1	1	1	3	1	3	2
CO 4	3	1	1	1	2	2	-	1	1	1	1	2	1	3	3
CO 5	-	-	1	1	2	-	2	-	1	-	-	2	-	3	-

UNIT – I

Healthcare Data Sources and Introduction to Analytics:

Introduction to the healthcare ecosystem and data importance, Clinical vs. non-clinical data: definitions and differences, Electronic Health Records (EHRs): formats, standards (HL7, FHIR), and challenges, Biomedical image data: DICOM standard, sources (MRI, CT, X-ray),Sensor data in modern healthcare: fitness trackers, remote monitoring devices, Basic statistical concepts for healthcare data: mean, median, standard deviation, correlation.

UNIT – II

Biomedical Signal: Overview of biomedical signals: ECG, EEG, EMG, and their importance, Techniques for sensor data mining: feature extraction, anomaly detection, Biomedical signal processing: filtering, segmentation, transformation, Data preprocessing and integration techniques for heterogeneous healthcare data.

UNIT – III

Unstructured Data and Text Analytics in Healthcare:

Natural Language Processing (NLP) techniques in healthcare: tokenization, entity recognition, classification, Mining biomedical literature: tools (PubMed,BioNLP), challenges, Information retrieval systems for clinical documents, Semantic search and use of ontology's (UMLS, SNOMED CT), Text summarization and sentiment analysis in clinical applications.

UNIT – IV

Advanced Analytics and Predictive Modelling in Healthcare:

Clinical prediction models: logistic regression, decision trees, ensemble methods, Temporal data mining: sequential pattern mining, time-series analysis in patient data, Visual analytics: dashboards, heatmaps, patient trajectory visualizations, Multi-modal learning and data fusion methods.

UNIT – V

Applications and Practical Systems in Healthcare:

Clinical Decision Support Systems (CDSS): architecture and real-time decision Making, Computer-assisted medical imaging systems: segmentation, detection, and classification, Review of real-world platforms: Google Health AI, Microsoft Cloud for Healthcare, Case studies: AI in radiology, Predicting Mortality for cardiology Practice.

Textbook:

1. Health Care Data Analytics, Authors: Chapman &Hall_CRC (data mining and knowledge discovery series) Aggarwal, Charu C._ Reddy, Chan

Reference Books

ChandanK.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.
Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.

Web Reference

https://www.coursera.org/learn/healthcare-analytics-essentials
https://www.coursera.org/specializations/healthcare-information-literacy-data-analytics

22ADE86N

AI AND CYBER FORENSICS

(Professional Elective #6)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite:

Course Objectives:

This course aims to:

Make students understand the basic principles and phases of digital forensics, including identification, collection, analysis, and legal procedures.

Familiarize students with the application of machine learning and deep learning techniques in digital forensic investigations.

Enable students to understand computer foundations, data formats, and the digital investigation process essential for forensic analysis.

Make students learn the use of forensic tools, hard disk analysis methods, and Python scripting for evidence acquisition and validation.

Course Outcomes:

Upon completion of this course, students will be able to:

Describe the core concepts, types, and legal aspects of digital forensics and their role in cyber investigations.

Apply machine learning and deep learning techniques to solve digital forensic problems.

Utilize command-line tools and scripts for hard disk forensic investigations.

Analyse the digital forensic tools and techniques for data acquisition, validation, and evidence integrity.

Apply AI and ML in Forensic Analysis.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	2	2	-	-	-	-	-	-	2	2	2	2
CO 2	-	1	1	1	-	-	-	-	-	-	-	1	1	2	-
CO 3	2	1	1	1	-	-	-	-	-	-	-	2	1	2	2
CO 4	2	1	1	1	-	-	-	-	-	-	-	1	1	2	2
CO 5	-	1	1	1	-	-	-	-	-	-	-	1	1	2	-

UNIT- I

An Overview of Digital Forensics: What Is Digital Forensics? Identification, Collection and Preservation, Examination and Analys, Presentation, Artificial Intelligence for Digital Forensics, Digital Forensics and Other Related Disciplines, Different Types of Digital Forensics and How They Are Used, Types of Digital Evidence, Cloud Forensics in IoT, Understanding Law Enforcement Agency Investigations, Understanding Case Law, Significant Areas of Investigation for Digital Forensics, Following Legal Processes, The Cyber Kill Chain.

UNIT - II

An Introduction to Machine Learning and Deep Learning for Digital Forensics: History of Machine Learning, What Is Machine Learning, Supervised Learning- Decision Trees, Support Vector Machine, K-Nearest Neighbours, Naive Bayes, Neural Networks, Unsupervised Learning, What Is Deep Learning- Discriminative Deep Learning-Recurrent Neural Network (RNN), Convolutional Neural Network (CNN), Generative Deep

Learning-Deep Auto Encoder, Recurrent Neural Network (RNN), Evaluation Criteria of Machine and Deep Learning, Case Study of Machine Learning-Based Digital Forensics.

UNIT - III

Fundamentals of Hard Disk Analysis: Introduction, Storage Media -Rigid Platter Disk Technology, Solid State Technology, Hard Disk Forensic Features- Garbage Collection, TRIM Command, Methods of Accessing Hard Disk Addresses, Hard Disk Settings- Disk Types, Partition Architectures, File Systems, The Boot Process, Essential Linux Commands for Digital Forensics Basics, Python Scripts for Digital Forensics Basics-Executing a DoS Attack.

UNIT- IV

Digital Forensics Requirements and Tools: Introduction, Computer Forensic Requirements, Evaluating Needs for Digital Forensics Tools- Types of Digital Forensics Tools, Tasks Performed by Digital Forensics Tools, Data Acquisition Tools and Formats, Anti-Forensics, Evidence Processing Guidelines, Implementation of Data Validation and Acquisition Phases, Hash Functions, Authentication and Validation in Digital Forensics, Python Scripts for Hashing, MD5, SHA1, Example of Hashing Passwords, Hashing and Data Acquisition, Data Acquisition Using WinHexs.

UNIT V

Machine Learning Trends for Digital Forensics Introduction, Why Do We Need Artificial Intelligence in Digital Forensics? Artificial Intelligence for Digital Forensics, Machine Learning for Digital Forensics, Machine Learning Basics Machine Learning Process, Data Collection and Pre-Processing, Training and Testing Phases, Applications of Machine Learning Models, Machine Learning Types, **Case Study: Using the TON_IoT Dataset for Forensics.**

Text Book:

Digital Forensics in the Era of Artificial Intelligence, Dr. Nour Moustafa, CRC Press, Tylor & Francis Group, 2023.

Reference Books:

Guide to Computer Forensics and Investigations, Bill Nelson, Amelia Phillips, Christopher Steuart, 6th Edition, Cengage India Private Limited, 2020.
Digital Forensics and Incident Response, Gerard Johansen, Second Edition, Packt Publishing, 2020.
Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, Yoshua Bengio, and Aaron Courville, The MIT Press, 2016.
"Machine Learning for Cybersecurity Cookbook" – Soma Halder, Sinan Ozdemir.

Web Resources:

https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0?active-tab=description-tab
https://www.mygreatlearning.com/academy/learn-for-free/courses/cyber-forensics
https://www.udemy.com/course/digital-forensics/?srsltid=AfmBOorqJWqTP8IbB5-wRzEQwSgntb6B8GGuBr9L3Jpj2fF6hFiyImV7
https://developers.google.com/machine-learning/crash-course
https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-deep-learning

22CIE24

IMMERSIVE TECHNOLOGIES

(Professional Elective#6)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites

Basic knowledge on XR devices (Oculus Quest, HoloLens, HTC Vive), linear algebra, vectors, and 3D geometry and Python, C++, C#, or JavaScript — especially for Unity or Unreal Engine development

Course Objectives

To provide an understanding of Virtual Reality, its core concepts, and its role as a medium for immersive communication and interaction.

To explore the role of human perception, interaction, and presence in virtual environments, emphasizing the concept of the human-in-the-loop in immersive systems.

To understand the methods and technologies used to interface participants with virtual environments and effectively present immersive experiences.

To examine interaction techniques and system components that enable dynamic engagement and realism within virtual environments.

To understand the principles of designing meaningful VR experiences for real-world applications and to explore the evolution and future potential of virtual reality technology.

Course Outcomes

By the end of this course, students should be able to:

Describe the fundamental principles of Virtual Reality and analyze its role as a medium for immersive communication and interaction.

Evaluate the impact of human perception, presence, and interaction in virtual environments with a focus on the human-in-the-loop paradigm.

Identify and explain the technologies used for interfacing users with virtual environments, including output presentation techniques.

Apply interaction models and system components to create responsive and engaging virtual experiences.

Design context-based VR solutions for real-world problems and assess the past developments and future scope of VR technologies.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	3	3	3	1	-	-	-	-	-	3	-	-
CO 2	3	3	3	3	2	-	-	-	-	-	3	-	-
CO 3	3	3	3	3	3	-	-	-	-	-	3	-	-
CO 4	3	3	3	3	3	-	-	-	-	-	3	-	-
CO 5	3	3	3	3	3	-	-	-	-	-	3	-	-

Unit – I

Introduction to Virtual Reality: Definition – Elements of VR experience-VR, Telepresence, AR and Cyberspace. VR: The Medium: A Mediums content – Communication: Conveyance of Ideas – Common Issues of Human Communication media- The study of the medium of VR.

Unit – II

The Human in the Loop: Connecting humans to simulation – The Human perceptual system – Presence and Embodiment: Self perceptions within the virtual world. Input: Interfacing the Participant(s) With the Virtual World: Input Technologies – Using inputs within a VR system

Unit – III

Output: Interfacing the Virtual World with the Participant(s): Visual Displays – Aural Displays – Haptic Displays- Vestibular and other Sensory Displays. **Presenting the Virtual World:** Representation of Virtual world – Visual representation in VR – Aural representation in VR - Haptic representation in VR – Representation of other senses – Visual rendering systems – Sonic Rendering systems – Haptic Rendering systems – Rendering of other senses.

Unit – IV

Interacting With the Virtual World: Interaction design Basics – User Interface Metaphors – Manipulating and Navigating in a virtual world – Interacting with others and with VR system (Meta commands). **Bringing the Virtual World to Life:** Immersion – Providing the context – The virtual world – Rules of the virtual world: Physics – S/w to manifest the VR experience – The experience creation process.

Unit – V

Experience Conception and Design: Applying VR to a Problem: Conceiving a New VR applications – Exemplary VR Experience – Designing a VR experience – The past and the future of VR design. **Virtual Reality: Past, Present, Future:** The state of VR – The maturation of VR – Trends – Technology the future and past predictions.

Textbook:

"Understanding Virtual Reality: Interface, Application, and Design", Authors: William R. Sherman & Alan B. Craig, Publisher: Morgan Kaufmann, Edition: 2nd Edition (latest)

Reference Books:

1. Immersive Realm of Extended Reality, Author Suman Dutta, First Edition 2024, Copyright © BPB Publications, India, ISBN: 978-93-55517-227.
2. VIRTUAL REALITY, Steven M. LaValle, University of Oulu, Cambridge University Press.
3. Virtual and Augmented Reality- An Educational Handbook, By Zeynep Tacgin, Cambridge Scholars Publishing Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK
4. Virtual Reality Technology, Grigore C. Burdea, Philippe Coiffet, John Wiley & Sons, 30 Jun 2003 - Computers - 464 pages
5. Handbook of Augmented Reality, Borko Furht, Springer New York, NY, Hardcover ISBN 978-1-4614-0063-9, eBook ISBN 978-1-4614-0064-6

Web Reference:

https://www.edx.org/certificates/professional-certificate/ucsandiegox-virtual-reality-app-development

22MBO04

ENGINEERING LEADERSHIP

(Open Elective#3)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. To develop an understanding of the basics of Leadership and Leadership Behavior.
2. To introduce them the concepts of Adaptive Leadership and Decision making as a Leader.
3. To discuss the importance and components of Change and Cross-Cultures in the Global era.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply the knowledge of behavior and effectiveness of Leadership in real time situations.
2. Understand the dynamics of Situations and Adaptive Leadership and its importance in leading.
3. Appraise the process of Decision Making and Empowerment and Leading in the Global Era.
4. Develop understanding towards dealing with Change, Power and Influence Tactics.
5. Interpret and improve in cross-Cultural Management and Leadership Skills.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1		1	1	1	1	2	1	1		2
CO2	1	2	2	2		1	2	2	2	1	2
CO3	1	1	2	2	1	1	1	1	2		1
CO4		2	1	2	2	1	2	2	2	1	2
CO5		1	1	1	1	1	2	2	2	1	1

UNIT - I

Nature and Behavior of leadership: Definitions of Leadership-Indicators of Leadership Effectiveness-Research Methods for Studying Leadership effectiveness-important Types of Leadership Behavior-Specific Task Oriented Leader Behaviors- Specific Relations Oriented Leader Behaviors.

UNIT - II

The leadership Situation and Adaptive Leadership: Different ways Situations affect Leaders- Stewart Model of Situational Determinants-Other Situational Determinants of Leader Behavior- Guidelines for Coping with Demands and Constraints-Early Contingency theories of Effective Leader Behavior-Guidelines for flexible, Adaptive Leadership.

UNIT - III

Decision Making and Empowerment by Leaders: Decision making- Participative Leadership- Normative Decision Model-Guidelines for Participative Leadership-Delegation-Guidelines for Delegating-Psychological Empowerment-Empowerment Programs-Benefits of Empowering Leadership and Programs.

UNIT - IV

Dealing with Change, Power and Influence Tactics: Types of Change in Teams and Organizations- Change Processes-Reasons for Accepting or Rejecting Change-implementing Change-guidelines for Implementing Change-How Visions influence change-Sources of Power-How Power is gained or lost- consequences of Power-Guidelines for using Power-Influence Tactics and Outcomes-Types of Proactive Influence Tactics-Power and influence Behaviour-Effectiveness of Proactive Tactics- guidelines for using Proactive Influence Tactics.

UNIT - V

Developing Cross-Cultural Leadership and Skills of Leadership: Cross-Cultural and Global Leadership-Cultural Values and Leadership-Guidelines for Global Leadership-Gender and Leadership-Leadership Training Programs-Learning from Experience-Developmental Activities- Facilitating Leadership Development-Systems Perspective on Leadership Development.

Text Books:

1. Gary Yukl, William L. Gardner and Nishant Uppal, "Leadership in Organizations", Pearson Education, 9th Edition, 2019.
2. Keow Ngang Tang, "Leadership and Change Management", Springer – First Edition, 2019.
3. Patrick Dawson, Constantin Andriopoulos "Managing Change, Creativity and Innovation", Sage Publications ltd., 2nd Edition, 2014.
4. Lee R Beach, "Leadership and the Art of Change", Sage Publications ltd.,1st Edition, 2005.

Suggested Readings:

1. Ranjana Mittal, Leadership Personal Effectiveness and Team building, Vikas Publictaions, 2015
2. Peter G. Northhouse, Leadership Theory and Practice, Sage Publications, 2011.
3. Barbara Senior, Jocelyne Fleming, Organizational Change, 3e, Pearson publications, 2010
4. Mark Hughes, Managing Change, Universities Press, 2011.
5. Alfranch Nahavandi, The Art and science of Leadership, 7e, Pearson, 2018.

22MEO04

INTRODUCTION TO OPERATIONS RESEARCH

(Open Elective#3)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on basics of Mathematics

Course Objectives: This course aims to

1. Make the students come to know the formulation of LPP models.
2. Familiarize the students with the Algorithms of Graphical and Simplex Methods.
3. Make the students understand the Transportation and Assignment techniques.
4. Familiarize the students with the procedure of Project Management along with CPM and PERT techniques.
5. Make the students understand the concepts of sequencing and queuing theory

Course Outcomes: Upon completion of this course, the students are able to

1. Understand the concepts of linear programming problems and Solve
2. Solve the given transportation problem.
3. Develop optimum pair of operations and resources by using Assignment technique.
4. Analyze project management techniques like CPM and PERT to plan and execute project successfully.
5. Apply sequencing and queuing theory concepts for industry applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	1	1	-	-	1	3	2	2
CO2	2	1	1	-	1	-	1	-	-	-	1	3	2	2
CO3	1	1	1	-	-	2	-	-	-	2	1	3	2	2
CO4	3	-	-	-	-	-	1	-	-	-	2	3	2	2
CO5	2	1	1	-	-	2	-	1	-	2	1	3	2	2

UNIT-I

Introduction: Definition and scope of operations research.

Linear programming: Introduction, formulation of linear programming problems, graphical method of solving LP problem, simplex method, degeneracy in simplex, duality in simplex.

UNIT-II

Transportation models: Finding an initial feasible solution north west corner method, least cost method, Vogel's approximation method, finding the optimal solution, special cases in transportation problems unbalanced transportation problem, degeneracy in transportation, profit maximization in transportation.

UNIT-III

Assignment techniques: Introduction, Hungarian technique of assignment techniques, unbalanced problems, problems with restrictions, maximization in assignment problems, travelling salesman problems.

UNIT-IV

Project management: Definition, procedure and objectives of project management, differences between PERT and CPM, rules for drawing network diagram, scheduling the activities, Fulkerson's rule, earliest and latest times, determination of ES and EF times in forward path, LS & LF times in backward path, determination of critical path, duration of the project, free float, independent float and total float, crashing of network.

UNIT-V

Sequencing models: Introduction, General assumptions, processing 'n'jobs through two machines, processing 'n' jobs through three machines.

Queuing theory: Introduction, Kendall's notation, single channel Poisson arrivals exponential service times.

Text Books:

1. Hamdy A. Taha, Operations Research an Introduction, 10th edition, Pearson education India,2017.
2. S.D. Sharma, Operations Research, Kedarnath, Ramnath& Co., Meerut,2009.
3. V.K. Kapoor, Operations Research, S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. R. Paneer Selvam, Operations Research, 2nd edition, PHI Learning Pvt. Ltd., New Delhi,2008.
2. Nita H. Shah, Ravi M. Gor, Hardik Soni, Operations Research, PHI Learning Private Limited,2013.

22MEO05

RESEARCH METHODOLOGIES AND INNOVATION

(Open Elective#3)

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

Course Objectives:

This course aims to:

1. Make the students to formulate the research problem
2. Identify various sources for literature review and data collection.
3. Prepare the research design
4. Equip the students with good methods to analyze the collected data
5. Introduce students to the concepts of innovation

Course Outcomes:

Upon completion of this course, the students will be able to

1. Define research problem
2. Review and assess the quality of literature from various sources.
3. Understand and develop various research designs.
4. Collect and analyze the data using statistical techniques.
5. Apply creative thinking and innovative skills.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	1	2	1	1	-	1	-	1	2	2	2	3	2	3
CO 2	-	2	1	2	1	1	1	1	3	2	2	3	2	3
CO 3	1	2	3	2	2	1	-	1	2	-	1	3	2	3
CO 4	2	2	-	3	2	-	-	-	2	1	1	3	2	3
CO 5	2	2	3	2	3	1	-	-	-	-	3	3	2	3

UNIT – I:

Research Methodology: Objectives, Motivation and Significance of Research, Types of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information Primary, Secondary and tertiary, Assessment of Quality of Journals and Articles, Information through Internet **Research writing:** Format of the Research report, Writing a Synopsis, Dissertation, Research Proposal and Research Report

UNIT – III

Research Design: Meaning and Need of Research Design, Terminology used in Research Design, Features of a Good Research Design, Formulation of hypothesis, **O**perationalizing the research question, Different Research Designs – exploratory, descriptive, diagnostic and hypothesis testing research studies, Basic Principles of Experimental Design, Steps in Sample design

UNIT – IV

Data Collection and Analysis: Collection of primary data Observation, Interview and Questionnaire methods, Secondary data, Measures of central tendency, Measures of dispersion, Measures of asymmetry, Important parametric testsz, t, F, ChiSquare, ANOVA significance.

UNIT – V

Innovation: Creativity, Innovation and its difference, Blocks for creativity and innovation, overcoming obstacles, Examples of innovation, being innovative, Steps for Innovation, right climate for innovation, Design led innovation, Gross root innovation, Frugal and flexible approach to innovation.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008.

Suggested Reading:

1. Vijay Upgrade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.
3. JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.

Web Resources:

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://archive.nptel.ac.in/courses/107/101/107101088/

22MBO02

STRATEGIC ENTREPRENEURSHIP

(Open Elective#3)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Nil

Course Objectives:

This course aims to:

1. To understand the importance of generating new ideas through Entrepreneurship and identify the skills for making informed Business Decisions.
2. To provide insights on various branding, promotion, commercialization and financial planning.
3. To help the students develop their abilities for applying various Strategic Management Concepts in solving real time problems in Business.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Use innovative skills to generate ideas for new products and services.
2. Evaluate the feasibility of ideas, and develop a strategy from commercialization.
3. Use technology to select target markets, profile target customers, define venture's mission, and create business plans.
4. Take initial steps to establish a business.
5. Establish brand, setting prices, promoting products, and managing customer relationships.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	2	2	2	2	1	1	1	1	1	1	1
CO 2	1	2	2	2	2	1	1	1	1	1	1
CO 3	-	1	1	1	1	1	-	1	1	1	1
CO 4	1	-	-	1	1	1	1	1	1	1	1
CO 5	-	2	2	2	1	1	1	1	1	-	1

UNIT - I

Introduction: Identifying possible rewards and risks of business ownership, risks vs. rewards, risk factors, reasons for business success or failure; challenges with the growth of new business success, life cycle of an entrepreneurial business and challenges at different parts of the life cycle, necessary characteristics of an entrepreneur.

UNIT - II

Identifying the Possibilities: Skills needed to make decisions based on the limited information, essential questions, generate and develop ideas into new products and services for commercialization, steps and factors to turn an idea into revenue.

UNIT - III

Market Analysis: Determining the influencing factors on purchases, effects of branding, promotion types, benefits, and promotion channels, importance of small and large marketing segments.

UNIT - IV

Business Finance: Create, Analyze and interpret financial documents, purpose of budget, income statement, balance sheet, understanding and interpretation of information to make business decisions, tools, strategies, and systems to plan and monitor financial resources.

UNIT - V

Planning your Business: Basic necessary requirements to own and operate a business, differences between sole partnership, partnership and corporation; a public and private business; profit and non- profit corporation. Concept of insurance, advertisement strategies, Business and law, Corporate Social Responsibility (CSR), actualization of business and Performance assessment.

Text Books/ Suggested Readings:

1. Greene, C., "Entrepreneurship Ideas in Action", Thomson: South-Western, 2004.
2. Kennedy B. Reed, "Strategic Management", Virginia Tech, 2020.
3. Michaele A. Hitt, R D Ireland, Michael Camp, Dianal Sexton, "Strategic Entrepreneurship – Creating a New Mindset", John Wiley & Sons., 2017
4. Philip A. Wickham, "Strategic Entrepreneurship", 4th Edition, Pearson, 2006.
5. https://vtechworks.lib.vt.edu/bitstream/handle/10919/99282/Strategic Management.pdf?sequence=22&isAllowed=y
6. http://www.chillicothecityschs.oh.schools.bz/userfiles/319/My%20Files/Course%20syllabi%
7. 202017-2018/PRCTC/Black/2017-8%20Strategic%20Entrepreneurship%20Syllabus.pdf?id=4228

22EGO03

INDIAN TRADITIONAL KNOWLEDGE

(Open Elective #3)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Indian Culture.

Course Objectives:

This course aims to:

1. To get a knowledge in Indian Culture.
2. To know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval, and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO 1	1	1	2	1	1	2	2	2	1	2	1	1	1	1
CO 2	1	1	2	1	1	2	2	2	1	2	2	1	2	1
CO 3	1	1	2	1	1	2	2	2	1	2	1	1	1	1
CO 4	1	1	2	1	1	2	2	2	1	2	1	1	2	1
CO 5	1	3	2	1	1	2	2	2	2	3	2	2	2	1

UNIT I

Culture and Civilization: Culture, Civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian Cuisine, Martial arts.

UNIT II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient. Medieval and modern India. Concepts of Sciences in Indian Knowledge Systems.

UNIT III

Linguistic Wealth: Indian languages and Literature: The role of Sanskrit, Morphology and brevity of Sanskrit, Concepts of NLP in IKS. Paleography, Fundamentals of Vedic Mathematics, Significance of scriptures to current society, Indian semantics and lexicography, Darshana's.

UNIT IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, introduction to Mayamatam, Iron and Steel technology, Use of metals in medicinal preparations.

UNIT-V

Science and Logic: Heliocentric system, Sulbasutras, Katapayadi, Engineering in Vedas, Adaptability of Sanskrit in Computer languages, Related commands Hindu calendar, 6 Pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka- Induction and deduction, Ayurvedic biology, Definition of health.

Text Books:

1. B. Madhavan, Nagendra Pavana, Vinayak Rajat Bhat, "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning, June 2022.
2. Kapil Kapoor, "Text and Interpretation: The Indian Tradition", D K Print World Ltd., 2005.
3. Samskrita Bharati, "Science in Sanskrit",2017.
4. Satya Prakash, "Founders of sciences in Ancient India", Govindram Hasanand, 1986.
5.

Suggested Reading:

1. Brajendranath Seal**, "**The Positive Sciences of the Ancient Hindus", Motilal Banarasidass, 2016.
2. Kancha Ilaiah, "Turning the Pot, Tilling the Land: Dignity of Labour in Our Times", Navayana, 2019.
3. Balram Singh and others, "Science & Technology in Ancient Indian Texts", D.K. Print World Ltd, 1st edition, 2012.
4. Smt. Kalpama Paranjape, "Ancient Indian insight and Modern Science"**,** Bhandarkar Oriental Research Institute, 1996.
5. Pradeep Parihar, "Vedic World and Ancient Science", World House Book Publishing, 2021.

22ADC81N

TECHNICAL SEMINAR

Instruction	2 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Collect Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare Seminar Report in a prescribed format.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	3	1	2	2	2	3	3	3
CO2	0	2	2	1	1	3	3	1	1	3	2	2	0	1
CO3	3	2	2	2	1	3	3	0	1	2	1	3	3	2
CO4	3	2	2	2	1	3	3	0	1	2	1	2	0	1
CO5	3	2	1	1	2	3	3	0	1	3	2	2	0	1

The seminar must be clearly structured, and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
S. No.	Description	Max Marks
1.	Contents and Relevance	10
2.	Presentation Skills	10
3.	Preparation of PPT slides	05
4.	Questions and Answers	05
5.	Report in a prescribed format	20

22ADC82N

PROJECT PART-II

Instruction	8 Hours per Week
Duration of SEE	---
SEE	100 Marks
CIE	100 Marks
Credits	4

Course Objectives:

1. Enable the student to extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work.
2. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
3. Preparing an Action Plan for conducting the investigation, including teamwork.

Course Outcomes:

Upon successful completion of this course, students will be able to:

1. Develop and execute a comprehensive project plan, including timelines, resources, and milestones, to ensure successful project completion
2. Implement a solution to the identified problem using appropriate engineering techniques and tools.
3. Assess the effectiveness and efficiency of the implemented solution through testing and validation.
4. Produce a comprehensive project report detailing the problem, methodology, implementation, results, and conclusions
5. Disseminate findings through publication in formats like journal papers, conference presentations, or technical reports

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	2	2	3	2	1	3
CO2	3	3	2	3	3	2	2	2	2	2	3	3	2	1
CO3	3	3	3	2	2	2	2		1	1	2	2	1	2
CO4	3	2	3	2	2	2	2	1	2	3	2	2	2	2
CO5	3	2	2	1	1	2	2	2	3	3	2	2	2	3

Note:

1. Review and finalization of the Approach to the Problem relating to the assigned topic;
2. Preparing an Action Plan for conducting the investigation, including team work;
3. Detailed Analysis/ Modeling/Simulation/Design/Problem Solving/Experiment as needed;
4. Final development of product/process, testing, results, conclusions and future directions;
5. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
6. Preparing a Dissertation in the standard format for being evaluated by the Department.
7. Final Seminar presentation before Departmental Committee.

Guidelines for awarding marks in **CIE:** (**Max. Marks: 100**)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in **SEE**: (**Max. Marks: 100**)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiners	20	PowerPoint Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce