SCHEME OF INSTRUCTION AND SYLLABI

OF

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

FOR

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

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

(R–22A Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
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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&DataScienceanddevelopstateoftheartsolutionsinthefields 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.
3. Pursue higher studies in Artificial Intelligence and Data Science in reputed Universities and to work in research establishments.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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**	**27**	**410**	**490**	**20**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC01

LINEAR ALGEBRA & CALCULUS

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

Course Objectives:

This course aims to

1. To discuss Physical interpretations of scalar and vector functions.
2. To discuss vector line, surface and volume integrals.
3. To explain the concepts of basis, dimension of vector space and matrix representation of a linear transformation.
4. To explain the solution of system of linear equations by Matrix Methods.

Course Outcomes:

After the completion of this course, the student 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	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	1
CO 5	3	3	3	3	-	-	-	-	-	-	-	1

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, Jacobians, 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), Irrotational 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.

Text Books:

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. Veerarajan 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.

22PYC01

OPTICS AND SEMICONDUCTOR PHYSICS

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

Course Outcomes:

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

1. Demonstrate the physical properties of light.
2. Explain characteristic properties of lasers and fiber optics
3. Find the applications of quantum mechanics
4. Classify the solids depending upon electrical conductivity
5. Identify different types of semiconductors

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	2	2	3	2	2	2	1	1	2	1	2
C02	3	3	3	3	3	3	3	3	2	2	3	2
C03	3	3	3	3	3	2	3	2	1	2	1	2
C04	2	2	2	1	2	2	2	2	1	2	2	2
C05	3	2	2	2	2	2	3	3	2	2	3	2

UNIT-I

Wave Optics: Huygen's principle –Super position 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– Fraunhofer 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 –Fiberlosses--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.

Text Books:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P. G. Kshirsagar, *A Text Book 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.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, Mc Graw-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:
This course aims to:
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:
Upon completion of this course, students will be able to:
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	PO12	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, Datatypes, 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 Datatypes: 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.

Text Books:

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. Balaguruswamy, 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/.

22EGC01

ENGLISH

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:
This course aims to:
1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal Emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

Course Outcomes:
After the completion of this course, the student will be able to:
1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques.

CO-PO-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

UNIT-I
Understanding Communication in English: Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window. **Vocabulary &Grammar:** The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I: Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette. **Vocabulary & Grammar**: Use of cohesive devices and correct punctuation.

UNIT-III

Developing Writing Skills II: Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response. **Vocabulary and Grammar:** Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV

Developing Writing Skills III: Report writing – Importance, structure, elements of style of formal reports; Writing a formal report. **Vocabulary and Grammar:** Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V

Developing Reading Skills: The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. **Vocabulary and Grammar:** Words often confused; Use of standard abbreviations.

Text Books:

1. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.
2. Swan Michael, "Practical English Usage", OUP, 1995.

Suggested Readings:

1. Wood F.T, "Remedial English Grammar", Macmillan, 2007.
2. Zinsser William, "On Writing Well", Harper Resource Book, 2001.
3. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, 2011.

22PYC03

OPTICS AND SEMICONDUCTOR PHYSICS 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. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the conduction behaviour of semiconductor materials and optoelectronic devices.

Course Outcomes:

After the completion of this 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 lasers and optical fibers for engineering applications
4. Explain the V-I characteristics of some optoelectronic and semiconductor devices
5. Find the applications of thermistor

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	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 radius of curvature of a given plano-convex lens using Na vapor lamp
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 ofcharge 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 photo cell

NOTE: A minimum of TWELVE experiments should be done.

22EGC02

ENGLISH 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 nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behaviour while developing their ability to discuss in groups and making oral presentations.

Course Outcomes:

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

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

EXERCISES:

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions -** Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary –** weaving an imaginative story around a given picture.

9. **Information Gap Activity –** Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation –** Theme, poster preparation, team work and representation.

Suggested reading:

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011.
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016.

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 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 setup 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	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	–	1	1	1	1	1	3	3	2
CO2	3	2	3	2	2	1	–	1	2	1	1	2	3	2	2
CO3	3	2	2	3	2	-	-	-	1	2	-	2	3	1	2
CO4	3	2	3	2	2	-	-	-	1	1	2	3	3	3	1
CO5	3	2	2	1	2	-	-	-	-	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

Text Books:
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. Balaguruswamy, 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, student 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	PO12
CO 1	3	3	2	1	2	2		1	2	3	1	3
CO 2	3	2	2	1	2	2		1	2	2	1	2
CO 3	3	3	2	1	2	2		1	2	2	1	2
CO 4	3	3	3	2	2	2		1	2	2	1	2
CO 5	3	2	2	1	2	2		1	2	2	1	2

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.

Text Books:

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, “Text Book 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 team work 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 on 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 workshop 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	PO12
CO 1	1	1	1	1				1				1
CO 2	1		1									1
CO 3	1		1			1						1
CO 4	1		1			1						1
CO 5	2	2	2	1	3	1		1	1	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 threepin 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 threepin socket.

4 Stair case wiring Wiring of one light point controlled from two different places independently using two 2way 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 a 3D CAD model of a door bracket using a modelling 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 the CAD software./print the selected innovative component by the student using a 3D printer.

Text Books:

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 (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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**	**24**	**510**	**440**	**22**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC04

DIFFERENTIAL EQUATIONS & NUMERICAL METHODS

Instruction	3L+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:

After the completion of this course, the student 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	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	2	2	2	2	-	-	-	-	-	-	-	1
CO 4	2	2	2	2	-	-	-	-	-	-	-	1
CO 5	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 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.

Text Books:

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.

22CYC01

CHEMISTRY

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

Course objectives:

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nano materials and basic drugs of modern chemistry is essential.

Course Outcomes:

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

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role 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 domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	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. Numericals.

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, – 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).

Text Books:

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 behaviour 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 transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, 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	PO12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

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, Thevenin'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

Text Books:

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 + 1T Hours 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	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	-	-	-	-	-	-	1	3	2	2
CO2	2	2	2	-	1	-	-	-	-	-	-	1	3	2	2
CO3	2	2	2	-	1	-	-	-	-	-	-	1	3	1	2
CO4	2	2	2	-	1	-	-	-	-	-	-	1	3	1	2
CO5	2	2	2	-	1	-	-	-	-	-	-	1	3	1	1

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

Text Books:

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.

Web 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 SEE	3 Hours
SEE:	50 Marks
CIE	50 Marks
Credits:	1.5

Course Objectives:

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in Chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes:

After the completion of this course, the 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	PO12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Experiments:

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 Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids
    i. Conductometrically 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.

Text Books:

1. J. Mendham and Thomas, "Vogel's text book 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, life-style 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. Utilise the opportunities provided by Rural Development Programmes.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	-	3	3	1	2	-	-	2
CO2	-	1	2	2	-	3	2	-	2	1	-	1
CO3	-	1	1	2	-	2	2	1	3	1	2	1
CO4	2	2	3	2	-	2	2	1	2	2	1	-
CO5	1	2	2	1	-	1	1	-	1	-	1	1

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: SarvaShiksha Abhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

Text Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.

2. A Hand book 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 SEE	3Hours
SEE	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	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	1	-	-	-	-	-	-	1	3	2	2
CO2	2	2	2	-	1	-	-	-	-	-	-	1	3	2	2
CO3	2	2	2	-	1	-	-	-	-	-	-	1	3	1	2
CO4	2	2	2	-	1	-	-	-	-	-	-	1	3	1	2
CO5	2	2	2	-	1	-	-	-	-	-	-	1	2	1	1

LIST OF PROGRAMS:
1. Practice problems on Inheritance and Polymorphism
2. Implement the following sorting techniques: Insertion Sort, Selection Sort, Merge Sort, and 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.

Text Books:
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.

Web 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 quadcopter 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	PO12
CO 1	2	2	2	1	1	0	0	1	3	3	1	2
CO 2	1	2	2	1	1	0	0	1	3	3	1	2
CO 3	1	2	2	1	1	0	0	1	3	3	1	2
CO 4	2	2	2	1	1	0	0	1	3	3	1	2
CO 5	2	2	2	1	1	0	0	1	3	3	1	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	PO12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

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, subpackages and functions to enhance code organization, reusability and maintainability.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	3	3							1	3	3	3
CO 2	2	3	3	3	3							1	3	3	3
CO 3	2	3	3	3	3							1	3	3	3
CO 4	2	3	3	3	3							1	3	3	3
CO 5	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.
4. Implement **for** and **while** loops for iterating over sequences and repeating tasks with controlled

conditions.
5. Define functions with parameters and return values to break down code into manageable and reusable blocks.
6. Create and manipulate lists and tuples to store and manage ordered collections of data.
7. Leverage dictionaries to store and retrieve data efficiently using key-value associations.
8. Write programs to open, read from, and write to text files in Python for persistent data storage.
9. Design a simple class hierarchy (e.g., animals, shapes, vehicles) where you define classes, create objects, and demonstrate inheritance with methods and attributes.
10. Write Python scripts to handle exceptions.
11. Create a simple GUI with Tkinter library.
12. 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 (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.	22CSC15N	Operating Systems	3	-	3	40	60	3
3.	22CSC11N	Database Management Systems	3	-	3	40	60	3
4.	22ITC02N	Java Programming	3	-	3	40	60	3
5.	22ITC01N	Digital Logic and Computer Architecture	3	-	3	40	60	3
6.	22ADC06	Exploratory Data Analysis and Visualization	3	-	3	40	60	3
7.	22EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	Non-Credit
PRACTICALS								
8.	22CSC33N	Database Management Systems Lab	-	2	3	50	50	1
9.	22ITC03N	Java Programming Lab	-	2	3	50	50	1
10.	22ADC07	Exploratory Data Analysis and Visualization Lab	-	2	3	50	50	1
11.	22ADI01	MOOCs/Training/Internship	3-4 Weeks/ 90 Hours		-	50	-	2
TOTAL			**20**	**6**	**29**	**440**	**560**	**23**
Clock Hours Per Week: 26								

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE – Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC07

MATHEMATICAL AND STATISTICAL FOUNDATIONS

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

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.

Course Outcomes:

After the completion of this course, the student 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	PO12
CO 1	3	3	2	2	-	-	-	-	-	-	-	2
CO 2	3	3	2	2	-	-	-	-	-	-	-	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	2
CO 5	3	3	2	2	-	-	-	-	-	-	-	2

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.

Text Books:

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.

22CSC15N

OPERATING SYSTEMS

Instruction	3L 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	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-	1	1	1
CO 2	3	3	-	3	1	-	-	-	-	-	-	-	1	1	1
CO 3	3	3	2	1	1	-	-	-	-	-	-	-	1	1	1
CO 4	3	3	1	3	-	-	-	-	-	-	-	-	1	1	1
CO 5	3	3	2	3	1	-	-	-	-	-	-	-	1	1	1

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.

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. **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. **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 Case Studies:** Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits;

Defense: Overview, logging, auditing, and recovery, OS-level memory protection. Linux/Unix OS Design and architecture, Unix Shell.

Text Books:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. William Stallings, "Operating Systems Internals and Design Principles" Pearson Edition, 2012.
3. Ekta Walia Khanna, "Operating System Concepts", 2nd Edition, Publishing House, 2019.
4. Dhananjay Dhamdhare, "Operating Systems-A Concept Based Approach", 3rd Edition, McGraw Hill Education, 2017.

Suggested Reading:

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

Web Resources:

1. Remzi H. Arpaci-Dusseau and Andrea C. , "Three Easy Pieces", Arpaci-Dusseau 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).

22CSC11N

DATABASE MANAGEMENT SYSTEMS

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

Pre-Requisites: 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 SQL queries for tasks of various complexities.
3. Build applications using the database system as the backend.
4. Understand internal working of a DBMS including data storage, indexing, query processing, transaction processing, and concurrency control and recovery mechanisms.
5. Analyze query processing, transaction processing, and concurrency control and recovery mechanisms.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	2	2	-	-	-	-	-	-	1	-	-	2
CO 2	2	3	3	2	3	-	-	-	-	-	-	1	-	-	2
CO 3	2	1	2	1	3	-	-	-	-	-	-	-	-	2	3
CO 4	2	1	1	2	-	-	-	-	-	-	-	-	-	2	3
CO 5	2	1	-	2	-	-	-	-	-	-	-	-	1	-	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 Operations and 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 Subqueries, 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, creation of 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", McGraw-Hill, 7th Edition, 2021.
2. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Pubs, 7th Edition, 2017.
3. Lemahieu, Broucke and Baesens, "Principles of Database Management", Cambridge University Press, 2018.
4. RP Mahapatra, "Database Management Systems", Khanna Publishing House, 2020.
5. Krishnan, "Database Management Systems", McGraw Hill.

Suggested Reading:

1. MySQL Explained: Your Step By Step Guide To Database Design.
2. Pro SQL Server 2008 Relational Database Design and Implementation (Expert's Voice in SQL Server) 1st Edition.

Web Resources:

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

22ITC02N

JAVA PROGRAMMING

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. Deliver the object-oriented programming features and principles for code development.
2. Explore the reusability of the code, coupling and cohesion.
3. Handle the exceptions and multiple flow of the execution.
4. Understand the collection framework.
5. Develop the IO and database applications.

Course Outcomes:

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

1. Apply the concept of OOP to design, implement and execute programs.
2. Use the strings, interfaces, packages and inner classes for application development.
3. Apply the exception handling mechanisms and multithreading for the development.
4. Develop applications using collection framework.
5. Develop database applications using SQL package.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	2	-	1	2	1	2	2
CO2	2	2	3	2	2	1	-	1	2	1	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2
CO5	2	2	3	2	3	1	-	1	2	1	2	2

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.

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, Enumeration interfaces, differentiate Comparable and Comparator interface, Introduction to Java 8 Features, Lambda Expressions, Functional Interfaces.

UNIT-V

Streams: FileStream, ObjectStream, Serialization, Servlets: Introduction to Servlets, Servlet Life cycle, Database: Connecting to Database - JDBC, Drivers, Connection, Statement and its types, Result set, CRUD operations, Databases using JSP.

Text Books:

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.
3. Bruce W.perry “Java Servlet and JSP Cookbook”, O’reilly Media Inc., 2004.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, “Programming in Java”, Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, “An Introduction to Object-Oriented Programming with Java”, TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy “Programming with Java”, TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, ”Core Java, Volume I— Fundamentals”, 8th Edition, Prentice Hall, 2008.
5. K Somasundaram “Introduction to Java Programming” , Jaico Publishing House, 2016.
6. 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 logic gates, combinational and Sequential logic circuits.
2. To provide understanding of Digital Counters, Registers and Data representation.
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	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	-	-	1	1	1	1
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	2	1
CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	2	1	2	1
CO5	2	2	1	-	-	-	1	-	1	-	2	2	2	1	1

UNIT–I

Data Representation: Data Types, Number Systems, Octal and Hexadecimal Numbers, Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers, Fixed–Point Representation, and Floating –Point Representation. **Digital Logic Circuits :** Digital Computers, Logic Gates, Boolean Algebra, Map simplification, 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, **Instruction Formats:** Three Address Instructions, Two-Address Instructions, One-Address Instructions, Zero-Address Instructions, RISC Instructions, Addressing Modes, Data Transfer and Manipulation, Program Control, Multi core Processors and their Performance.

UNIT-IV

Input-Output Organization: Peripheral Devices, **Input-output Interface:** I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, First-In-First-Out Buffer, **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, solid state drive and Linear Tape Open Technology, **Associative Memory:** Hardware Organization, Match Logic, Read and Write Operations, **Cache Memory:** Associative Mapping, Direct Mapping, Set-Associative Mapping, **Virtual Memory:** Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table, Page Replacement.

Text Book:

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

Suggested Reading:

1. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", 2nd Edition, McGraw Hill, 2009.ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill, 1995.
2. William Stallings, "Computer Organization and Achitecture", 8th Edition,PHI.2010
3. Carl Hamachar, Varanasi, Zaky, "Computer Organization", 5th Edition, McGraw Hill.2002.
4. Ramesh S Gaonkar, ―Microprocessor Architecture, Programming and Applications with the8085‖, 5th Edition, Prentice Hall, 2002

Web Resources:

1. https://nptel.ac.in/courses/117106114Week1%20Slides1.1Introduction.pdf
2. https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ ECE545_lecture1_digital_logic_review.ppt
3. http://www.nptelvideos.in/2012/11/computer-organization.html

22ADC06

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

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

Prerequisite: Python Programming

Course Objectives:
This course aims to:
1. Introduce the Numpy library in Python to support storage and operations on large multi-dimensional arrays and matrices
2. Introduce large collection of mathematical functions to operate on multidimensional sequential data structures
3. Demonstrate the functionality of the Pandas library in Python for open source data analysis and manipulation
4. Demonstrate Data Aggregation, Grouping and Time Series analysis with Pandas
5. Introduce the Matplotlib library in Python for creating static, animated and interactive visualizations

Course Outcomes:
Upon completion of this course, students will be able to:
1. Create, manipulate, and analyze numerical data using NumPy arrays and associated functions.
2. Perform various preprocessing operations on datasets using Pandas Series and DataFrame objects.
3. Combine and manipulating complex datasets using a variety of Pandas techniques, including concatenation, merging, grouping, aggregation, and time series analysis,
4. Apply inferential statistics to analyze data, draw valid conclusions about populations, based on hypothesis testing, confidence intervals, and correlation analysis.
5. Create and interpret different types of data visualizations using Matplotlib and Seaborn.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	-	1	-	1	3	-	-	3
CO 2	3	3	2	3	3	-	-	-	2	-	1	3	1	-	3
CO 3	3	2	2	2	3	-	-	-	2	-	1	1	-	1	3
CO 4	3	1	1	2	2	-	-	-	2	-	1	-	-	-	2
CO 5	3	1	-	3	2	-	-	-	1	-	1	-	1	1	2

UNIT - I

Introduction to Numpy: Data types in Python - Fixed type arrays, creating arrays, array indexing, array slicing, reshaping arrays, array concatenation and splitting, Universal Functions, Aggregations, Broadcasting rules, Comparisons, Boolean Arrays, Masks Fancy Indexing, Fast Sorting using np.sort and np.argsort, partial sorting Creating Structured Arrays, Compound types and Record Arrays.

UNIT - II

Introduction to Pandas: Series Object, DataFrame Object, Data Indexing and Selecting for Series and DataFrames, Universal Functions for Index Preservation, Index Alignment and Operations between Series and DataFrames, Handling missing data, operating on Null values, Hierarchical Indexing.

UNIT - III

Combining Datasets: Concat, Append, Merge and Joins, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance functions - query() and eval()

UNIT - IV

Inferential Statistics - Normal distribution, Poisson distribution, Bernoulli distribution, z-score, p-score, One- tailed and two-tailed, Type 1 and Type-2 errors, Confidence interval, Correlation, Z-test vs T-test, F- distribution, Chi-square distribution, the chi-square test of independence, ANOVA

UNIT - V

Visualization with Matplotlib : Simple Line plots, Scatter plots, Visualizing errors, Density and Contour plots, Histograms, Binnings, Multiple subplots, Three-dimensional plotting with Matplotlib, Geographic data with Basemap, Visualization with Seaborn.

Text Books:

1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly Media, 2016.
2. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.

Suggested Reading:

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

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

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

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

Prerequisite: Basic Awareness of Indian Constitution and Government.

Course Objectives:

This course aims 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 the completion of this course, the student 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	PO12
CO 1	-	-	1	-	-	1	1	1	1	-	-	-
CO 2	-	-	2	-	-	3	2	2	1	-	-	-
CO 3	-	-	1	-	-	1	1	-	-	-	-	-
CO 4	-	-	1	-	-	1	1	-	-	-	-	-
CO 5	-	-	2	-	-	3	2	1	1	-	-	-

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. **#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.

Text Books:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Akademy, 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.

Web Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

22CSC33N

DATABASE MANAGEMENT SYSTEMS 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 become familiar with the concepts of structured query language.
2. To understand about programming language / structured query language (PL/SQL).
3. To learn database constraints, DCL, TCL and advanced SQL commands.
4. To 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 apply these functions to write simple and complex queries using SQLoperators.
2. Demonstrate Queries to retrieve and change data using Select, Insert, Delete and Update. ConstructQueries using Group by, Order by and Having Clauses.
3. Demonstrate Commit, Rollback, save point commands and formulate the Queries forCreating, Dropping and Altering Tables, Views, constraints.
4. Develop queries using Joins, Sub-Queries.
5. Develop PL/SQL code using Cursors, Exception, Composite Data Types and Procedures, Functions.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	-	1	3
CO 2	3	3	2	3	3	-	-	-	2	-	1	3
CO 3	3	2	2	2	3	-	-	-	2	-	1	1
CO 4	3	1	1	1	-	-	-	-	2	-	1	-
CO 5	3	1	-	1	-	-	-	-	1	-	1	-

List of Experiments:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, DataFunctions, Conversion Functions and other miscellaneous.
2. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
3. Queries to Retrieve and Change Data: Select, Insert, Delete and Update.
4. Queries using Group by, Order by, Having Clauses and Set operations.
5. Queries on Controlling Data: Commit, Rollback and Save point.
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 / Suggested Reading:

1. "Oracle: The complete Reference", Oracle Press.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.
3. Rick F Vander Lans, "Introduction to SQL", Pearson Education, 4th Edition, 2007.

Web Resources:

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

22ITC03N

JAVA PROGRAMMING LAB

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

Course Objectives:

This course aims to:

1. Deliver the basic principles of OOP.
2. Explore the object-orientation process in creating classes, object, etc.,
3. Demonstrate the inheritances and polymorphism.
4. Handle the exceptions in runtime and multithreading.
5. Develop the database applications.

Course Outcomes:

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

1. Practice the basics of OOPs to develop java applications.
2. Use the inheritance and interfaces for application development.
3. Apply the exception handling and multithreading to handle multiple flows of execution.
4. Develop applications using collection framework.
5. Apply the SQL concepts for application development.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	2	2	-	1	2	1	2	2
CO2	3	3	3	2	2	1	-	1	2	2	2	3
CO3	2	2	3	2	2	1	-	1	2	1	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2
CO5	3	3	3	2	3	1	-	1	2	2	2	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 dynamic method dispatch.
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/Enum Interface.
10. Develop a java program(s) to implement the features of JDK8.

11. Implement a java program(s) to implement the concept of Servlets and JSP.
12. Create a web application to implement CRUD operations using Servlets, JSP and Databases.

Text Books:

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.
3. Bruce W.perry "Java Servlet and JSP Cookbook", O'reilly Media Inc., 2004.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, "An Introduction to Object-Oriented Programming with Java", TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy "Programming with Java", TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I— Fundamentals", 8th Edition, Prentice Hall, 2008.
5. K Somasundaram "Introduction to Java Programming" , Jaico Publishing House, 2016.
6. 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

22ADC07

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:

This course aims to:

1. Impart a strong foundational understanding of NumPy arrays and their role in efficient numerical computing within Python.
2. Familiarize students with the diverse array of mathematical functions to perform a wide range of data manipulations and analyses.
3. Guide students to proficiently clean, transform, and analyze real-world datasets using pandas.
4. Facilitate the exploration of advanced Pandas features, such as hierarchical indexing and data merging and joining,
5. Equip students with skills to create informative and engaging visualizations using Matplotlib and Seaborn.

Course Outcomes:

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

1. Apply indexing, slicing, and reshaping techniques to extract, transform, and analyze numerical data within NumPy arrays.
2. Perform arithmetic operations, broadcasting, and other numpy functions to efficiently process and manipulate numerical data.
3. Apply Boolean masks and conditional statements to filter specific elements/from NumPy arrays
4. Implement various pandas functions to handle missing data, such as imputation, deletion, or interpolation, to ensure data quality and reliability.
5. Generate a wide range of 2D and 3D visualizations, including basic Matplotlib plots and specialized statistical graphs using Seaborn to draw useful insights about the data.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	1	-	-	-	-	-	-	3	-	-	2
CO 2	3	2	1	2	2	-	-	-	-	-	-	3	-	-	2
CO 3	3	1	2	2	2	-	-	-	-	-	-	3	3	3	3
CO 4	3	2	3	3	3	-	-	-	-	2	-	3	3	3	3
CO 5	2	2	3	2	3	-	-	-	-	2	-	3	2	3	2

List of Programs:

1. Implement indexing, slicing and reshaping on numpy arrays.
2. various operations on NumPy arrays, including arithmetic calculations, broadcasting
3. Apply Boolean operations on a numpy array to filter specific elements, sort the array, and manipulate it using Boolean masks.
4. Demonstrate identifying and handling missing data within Pandas DataFrames using various techniques, such as filling missing values, dropping rows or columns with missing data.

5. Demonstrate interpolation techniques to estimate missing values.
6. Demonstrate hierarchical indexing and Multi-Criteria based data retrieval using pandas.
7. Combine and analyze datasets using Pandas operations including merge, join, concatenate, grouping and aggregation.
8. Plot different types of visualizations (e.g., line plot, scatter plot, histogram, bar plot) using matplotlib.
9. Demonstrate 3D visualizations using matplotlib.
10. Create various Seaborn visualizations such as pair plots, contour plots, violin plots, and box plots to represent different aspects of your data.
11. Case Study: Perform exploratory data analysis on any given dataset

Text Books:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2016.
2. Samir Madhavan, "Mastering Python for Data Science", Packt Publishing, 2015.

Suggested Reading:

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

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

22ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	--
Mid Term Evaluation	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 to 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	PO12	PSO1	PSO2	PSO3
CO 1	1	1		1	1				1	1		1	1	1	1
CO 2	1	2		1	2		2		1	1		1	1	1	1
CO 3	1	2	2	2	2		2		2	1		2	2	2	1
CO 4	1	2	3	2	3		3		2	1		2	2	2	1
CO 5	1	2		1	2				2	2	3	3	3	3	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 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 (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.	22ADC08	Data Warehousing and Mining	3	-	3	40	60	3
3.	22CSC14N	Design and Analysis of Algorithms	3	-	3	40	60	3
4.	22ADC01	Fundamentals of Machine Learning	3	-	3	40	60	3
5.		Professional Elective – I	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.	22MTC17	Stochastic Process and Queueing Theory Lab	-	2	3	50	50	1
9.	22CSC34N	Design and Analysis of Algorithms Lab	-	2	3	50	50	1
10.	22ADC02	Machine Learning Lab	-	2	3	50	50	1
11.	22ADC04	Linux and Latex Lab	-	2	3	50	50	1
12.	22ADU01	Upskill Certification Course-I	60 Hours		-	-	-	0.5
			20	**8**	**32**	**440**	**610**	**22.5**
Clock Hours Per Week: 29								

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

Professional Elective #1	Digital Image Processing (22ITE02)	Web Technologies (22ITC17)	Mobile Application Development (22ITE04)	Design Thinking and Innovations (22ADE21)	Society 5.0 (22ADE22)

22MTC16

STOCHASTIC PROCESS AND QUEUEING THEORY

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. Learn methods to solve bivariate probability functions.
2. Know characterizing the random process.
3. Identify the tools for interpretating the random process.
4. Know the statistical techniques for random process.
5. Analyses the queuing models.

Course Outcomes:

After the completion of this course, the student will 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	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 2	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 3	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 4	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 5	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

Queueing 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 Processess" 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.

Suggested Reading:

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

22ADC08

DATA WAREHOUSING AND MINING

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. Understand the principles of Data warehousing and Data Mining.
2. Learn how to adapt the life cycle approach for a data warehouse project and methods for gathering requirements
3. Understand how the requirements definition determines data design
4. Understand the various aspects of the data extraction, transformation, and loading (ETL) functions and the of OLAP
5. Learn what exactly data mining is and understand how major data mining techniques works

Course Outcomes:

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

1. Design data warehousing solutions by understanding business intelligence evolution and evaluating various architectures and components.
2. Manage data warehouse projects by planning phases and defining business requirements
3. Design dimensional models and OLAP systems
4. Perform data extraction, transformation, and loading (ETL) processes
5. Apply core data mining techniques within data warehousing contexts.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	2	1	1	-	-	-	-	3	3	2	2
CO 2	2	2	3	1	-	-	-	-	-	-	-	3	3	2	2
CO 3	3	3	3	1	-	-	-	-	-	-	-	3	3	2	2
CO 4	2	2	3	3	2	-	-	-	-	-	-	3	3	2	2
CO 5	3	3	3	3	3	-	-	-	-	-	-	3	3	2	2

UNIT - I

Introduction to Data Warehousing: Need For Strategic Information, Failures of Past Decision-Support Systems, Operational Versus Decision-Support Systems, Data Warehousing - The Only Viable Solution, Data Warehouse Defined, The Data Warehousing Movement, Evolution of Business Intelligence**, Data Warehouse: The Building Blocks:** Defining Features, Data Warehouses And Data Marts, Architectural Types, Overview of the Components, Metadata in the Data Warehouse, Data lake, Zero ETL

UNIT- II

Planning and Project Management: Planning Your Data Warehouse, The Data Warehouse Project, The Development Phases, The Project Team, Project Management Considerations, **Defining the Business Requirements**: Dimensional Analysis, Requirements Gathering Methods

UNIT- III

Dimensional Modelling & Online Analytical Processing (OLAP) : From Requirements to Data Design ,The Star Schema, Star Schema Keys, Advantages of the Star Schema, Star Schema: Examples, The Snowflake Schema, **OLAP in the Data Warehouse:** Demand for Online Analytical Processing, Major Features and Functions, OLAP Models, OLAP Implementation Considerations

UNIT - IV

Data Extraction, Transformation, and Loading: ETL Overview, ETL Requirements and Steps, Data Extraction, Data Transformation, Data Loading

UNIT- V

Introduction to Data Mining: Data Mining Basics: Data Mining Defined, The Knowledge Discovery Process, OLAP versus Data Mining, Some Aspects of Data Mining, Data Mining and the Data Warehouse, Major Data Mining Techniques, Data Mining Applications

Text Book:

1. Ponniah, Paulraj. Data warehousing fundamentals for IT professionals. John Wiley & Sons, 2011.

Suggested Books:

1. J. Han and M. Kamber, " Data Mining Tools and Technique s", Morgan Kaufmann Publishers
2. M. Humphires, M.Hawkins, M.Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.

Web Resources:

1. https://hanj.cs.illinois.edu/bk3/
2. https://www.coursera.org/specializations/data-mining
3. https://www.coursera.org/learn/getting-started-with-data-warehousing-and-bi-analytics

22CSC14N

DESIGN AND ANALYSIS OF ALGORITHMS

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

Pre-Requisites: Basics of Data structures and algorithms.

Course Objectives:

This course aims to:

1. To provide an introduction to formalisms to understand, analyze and denote time complexities of algorithms.
2. To introduce the different algorithmic approaches for problem solving through numerous example problems.
3. To 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 to measure the performance of algorithms.
2. Describe the algorithmic design techniques of divide and conquer, greedy, dynamic programming, backtracking and branch and bound to solve problems.
3. Apply suitable algorithmic design techniques to solve problems to get optimal solution.
4. Analyze the performance of algorithmic design techniques.
5. Evaluate the efficiency of alternative solutions derived for a problem by applying various algorithmic design techniques.
6. Formulate approximate solutions to NP problem.

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	2	1
CO 2	3	3	2	-	-	-	-	-	-	-	-	-	2	2	2
CO 3	2	2	2	-	-	-	-	-	-	-	-	-	2	2	1
CO 4	2	2	1	-	-	-	-	-	-	-	-	-	1	2	2
CO 5	2	2	1	-	-	-	-	-	-	-	-	-	2	2	2
CO 6	2	3	1	-	-	-	-	-	-	-	-	-	2	1	2

UNIT - I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method, Minimum and Maximum Problem, Strassen's algorithm for matrix multiplication.**Analysis of recursive algorithms through recurrence relations:** Substitution 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, Optimal Binary search tree.

UNIT - III

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

UNIT - IV

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

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 and Subset Sum Problem.

Text Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press/McGraw-Hill, 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.

Web Resources:

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

22ADC01

FUNDAMENTALS OF MACHINE LEARNING

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. 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	PO12	PSO1	PSO2	PSO3
CO 1	-	1	-	2	-	-	-	-	-	-	-	1	2	2	3
CO 2	1	1	1	1	-	-	-	-	-	-	-	1	2	3	3
CO 3	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 4	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 5	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. Aurelien 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:

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

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

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. Demonstrate the importance of Managerial Economics in Decision Making.
2. Explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. Understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes: After the completion of this course, the 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 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	PO12
CO 1	1	1	3	1	1	1	1	1	1	1	-	-
CO 2	2	2	2	2	-	1	1	1	-	1	-	1
CO 3	1	2	1	2	2	-	2	1	-	1	-	-
CO 4	2	2	1	2	2	1	1	3	-	1	-	-
CO 5	1	3	1	2	1	1	2	-	-	1	2	1

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, Equimarginal 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 Isocosts, 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. A.R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018.

22CEM01

ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

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

Course Objectives: This course aims to

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
3. To enable the students become aware of pollution of various environmental segments including their causes, effects, and control measures. To create awareness about environmental legislations in the context of national conventions.

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

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	-	-	-	-	-	3	-	-	-	-	1
CO 2	1	-	-	-	-	-	2	1	-	-	-	1
CO 3	1	-	-	-	-	-	2	1	-	-	-	1
CO 4	1	-	-	-	-	1	2	1	-	-	-	1
CO 5	1	-	-	-	-	1	2	1	-	-	-	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 & Wild life 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

22ITE02

DIGITAL IMAGE PROCESSING

(Professional Elective – I)

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 the fundamental concepts and applications of digital image processing.
2. Impart knowledge on the image processing concepts: intensity transformations, spatial filtering, Smoothing and sharpening both in spatial and frequency domain.
3. Familiarize the image analysis concepts: morphological image processing, image segmentation, image representation and description, and object recognition.
4. Introduce colour image processing techniques.
5. Understand with various image compression methods.

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

1. Understand the fundamentals of digital image processing, including image formation, color models, and digital representation.
2. Apply spatial and frequency domain techniques for image enhancement and restoration.
3. Develop and implement algorithms for image segmentation, feature extraction, and image compression.
4. Analyze and evaluate the performance of various image processing techniques.
5. Utilize modern software tools and programming languages to implement and test image processing algorithms.

CO-PO Articulation Matrix:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	2	1	1	-	-	-	1	1	1	1	3	3	3
CO 2	3	3	3	2	2	-	-	-	1	1	1	1	3	3	3
CO 3	3	3	3	3	2	-	-	-	1	1	1	1	3	3	3
CO 4	3	3	3	2	2	-	-	-	1	1	1	1	3	3	3
CO 5	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3

UNIT-I

Introduction: Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Some Basic Relationships between Pixels; **Intensity Transformations:** Some Basic Intensity Transformation Functions, Histogram Processing - Histogram Equalization, Histogram Matching (Specification)

UNIT-II

Spatial Filtering: Fundamentals of Spatial Filtering, Smoothing Spatial Filters; Sharpening Spatial Filters;

Filtering in the Frequency Domain: The 2-D Discrete Fourier Transform and its inverse; The Basics of Filtering in the Frequency Domain; Image Smoothing Using Frequency Domain Filters - Ideal, Butterworth and Gaussian Low pass Filters; Image Sharpening Using Frequency Domain Filters - Ideal, Butterworth and Gaussian High pass Filters.

UNIT-III

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models; Restoration in the Presence of Noise Only—Spatial Filtering; Periodic Noise Reduction by Frequency Domain Filtering; Estimating the Degradation Function; Inverse Filtering; Minimum Mean Square Error (Wiener) Filtering; **Morphological Image Processing**: Preliminaries; Erosion and Dilation; Opening and Closing, The Hit or Miss Transform

UNIT-IV

Image Segmentation: Fundamentals; Points, Line and Edge Detection, Thresholding; Segmentation by Region Growing, Region Splitting and Merging

Feature Extraction: Boundary Pre-processing, Boundary Feature Descriptors, Some Simple Region Descriptors.

Image Pattern Classification: Patterns and Pattern Classes, Pattern Classification by Prototype Matching

UNIT- V

Colour Image Processing: Colour Fundamentals; Colour Models, Pseudo Colour Image Processing, Basics of full Colour Image Processing;

Image Compression: Fundamentals, Huffman Coding, Arithmetic Coding, LZW Coding

Text Book:

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2020.

Suggested Reading:

1. Vipula Singh, ―Digital Image Processing with MatLab and lab View‖, Elsevier.
2. Thomas B. Moeslund, ―Introduction to Video and Image Processing: Building Real Systems and Applications‖, Springer, 2012.
3. Milan Sonka, Vaclav Halvac and Roger Boyle, ―Image Processing, Analysis, and Machine Vision‖, 2nd Edition, Thomson Learning Publishers.
4. Kenneth R.Castleman, ―Digital Image Processing‖, Pearson Education, 2006.

Web Resource:

1. www.imageprocessingplace.com
2. https://in.mathworks.com/discovery/digital-image-processing.html
3. https://imagemagick.org/
4. https://nptel.ac.in/courses/117105079/

22ITC17

WEB TECHNOLOGIES

(Professional Elective – I)

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. Understand how HTML, CSS, JavaScript and Bootstrap work together.
2. Explore various features of JS and its functionality.
3. Understand the basics of MongoDB and its Data Model.
4. Comprehend the new features of JS, role of React JS in responsive web application development.
5. Familiarize with configuration of NPM and backend integration with NODE JS and Express JS.

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

1. Create web pages with good aesthetic sense of design using HTML CSS3, Bootstrap and popular themes.
2. Use JS in Validations and DOM manipulation.
3. Design Schema and perform CRUD operations from UI components.
4. Become an agile practitioner with the ability to quickly complete projects using ReactJS.
5. Build an end-to-end application from scratch using React JS, NODE JS, Express JS and Mongo DB.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	1	1	-	-	-	1	1	1	1	2	2	2
CO 2	2	1	2	1	2	-	-	-	-	-	1	-	2	2	2
CO 3	2	1	2	2	1	-	-	-	-	-	-	-	2	2	2
CO 4	2	1	1	1	1	-	-	-	-	-	-	1	2	2	2
CO 5	2	1	1	1	1	-	-	-	-	-	-	1	2	2	2

UNIT-I

Introduction: Web Fundamentals, **HTML 5.0:** basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. Grid.

Introduction to Cascading Style Sheets: Types of CSS**,** text and font, color**,** CSS Selectors, CSS BOX Model, CSS Positioning, and CSS floating.

Bootstrap: Introduction of Bootstrap, Container and Container-fluid, Jumbotron, Grid, Table, Form, Alert, Navbar, Modals.

UNIT-II

Java Script: Introduction, data types, control structures, functions, arrays, objects, regular expressions, working with events, form validation, DOM Elements, Accessing and modifying Elements using DOM, Dynamic document with Java script.

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UNIT-III

Mongo DB: Introduction, Importance of NoSQL databases, Data types, Documents, nested Documents, CRUD Operations, Basic cursor methods: map, toArray, pretty, forEach, limit, count, sort, Columnar Databases, Indexing and Aggregation, MongoDB Node JS Drivers and CAP theorem.

UNIT-IV

React Js: ES5 vs Es6, Scoping - var vs let vs const, Arrow functions, Use of this keyword (lexical scoping), Spread & rest parameter, Array & object destructure, module import and export, State, Props, Components, Lifecycle, Stateful and stateless components, Events, Router, Forms, Tables, Portals, CSS, Hook and new Features added in recent versions.

UNIT-V

Node JS: Creating Web Server, Functions, Buffer, Node Modules, Creating Web Server, Handling HTTP requests.

Express JS: API methods - GET, POST, PUT, DELETE, Request & response objects, URL and Query parameters, Routing, Templates, middleware and the model-view-controller pattern.

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.
2. Shelly Powers, "Learning Node: Moving to the Server-Side", 2nd Edition, O"REILLY, 2016.
3. Simon D. Holmes and Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Second Edition, Manning Publications, 2019
4. Brad Dayley, "Node.js, MongoDB and Angular Web Development", 2nd Edition, Addison-Wesley Professional, 2017.

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.anarchocopy.org/Programming%20Languages/Node/Pro%20MERN%20Stack,%202nd%20Edition.pdf

22ITE04

MOBILE APPLICATION DEVELOPMENT

(Professional Elective – I)

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 the Kotlin Programming Language for Mobile Application Development.
2. Demonstrate the development of basic mobile applications on android operating system.
3. Implement the design using specific mobile development frameworks.
4. Demonstrate the Location based services in mobile application design.
5. Demonstrate their ability to deploy the mobile applications in the marketplace for distribution.

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

1. Understand the benefits of using Kotlin for Mobile application development.
2. Design user interface for mobile applications.
3. Use Intent, Broadcast receivers and Internet services in Android App.
4. Use multimedia, camera and Location based services in Android App.
5. Apply best practices to implement databases and publish apps on Playstore.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	2	1	2	-	2	-	-	-	1	-	-	1	2	2
CO 2	-	2	1	2	-	2	-	-	-	-	-	-	1	1	1
CO 3	-	2	1	2	-	2	-	-	-	-	-	-	-	-	1
CO 4	-	2	1	2	-	2	-	-	-	-	-	-	1	2	2
CO 5	-	2	2	2	3	2	-	-	3	-	-	1	1	2	2

UNIT-I

Introduction to Kotlin - Basic expressions - Control flow statements - null safety – Functions- passing functions as arguments - simple lambdas. Object oriented programming in Kotlin - Classes and Objects – Constructors - Visibility modifiers - Subclasses and Inheritance – Interfaces - Data classes - Singleton class – Pairs- Triples.

UNIT-II

Introduction to Android Architecture: History - Features and Android Architecture – Android SDK Tools - Application Components - User Interface Design - Views - View Groups – Layouts - Event Handling – Listeners – Adapters – Menus - Action Bars – Android Localization.

UNIT-III

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS. Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity. Notifications – Creating and Displaying notifications, Displaying Toasts.

UNIT-IV

Camera –Playing audio/video - Media recording - Sensors - Listening to sensor readings – Bluetooth - Android Communications – GPS - Working with Location Manager, Working with Google Maps extensions - Maps via intent - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location.

UNIT-V

Content Providers – Uri - CRUD access –Browser – CallLog – Contacts – Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases - Deploying Android Application to the World.

Text Books:

1. Reto Meier, “Professional Android 4 Development”, John Wiley and Sons, 2012.
2. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015.

Suggested Reading:

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Wei-Meng Lee, Beginning Android 4 Application Development, 4th Edition, Wiley India (Wrox), 2013.

Web Resources:

1. https://developer.android.com
2. http://www.androidcentral.com/apps
3. https://www.opensesame.com/c/android-app-development-beginners-training-course

22ADE21

DESIGN THINKING AND INNOVATIONS

(Professional Elective – I)

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

Course Objectives:

1. To introduce the idea of Human-centered design and design thinking.
2. To understand the concept of empathy and its technique.
3. To understand observation phase and insight concepts in design thinking.
4. To leverage the use of prototype in design thinking
5. To design business models using the design thinking innovations.

Course Outcomes:

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

1. Understand and apply human-centered design process and planning of design thinking project
2. Use empathetic design in the interview process
3. Identify need for observations and insights problems and come up with creative ideas in design thinking
4. Understand, build and test the prototypes
5. Apply design thinking and innovation techniques to develop successful business models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	1	1	2	2	3	2	2	2	2	1
CO2	1	2	2	1	2	1	1	2	3	3	1	1	2	3	1
CO3	1	3	2	2	1	1	1	1	2	2	1	2	2	3	2
CO4	2	1	3	2	3	1	1	1	2	3	1	1	3	2	2
CO5	3	2	2	1	2	2	3	1	2	2	3	2	3	3	2

UNIT-I

Human-Centered Design: Introduction to Human-centered Design, Applications of Human-centered Design, Design Process, Mindsets of Humancentered designer, Principles and process of Design Thinking, Planning a Design Thinking Project

UNIT-II

Interviewing & Empathy-Building Techniques: Introduction to Empathy, Practicing Empathy, Empathy vs. Sympathy, Methods for Empathetic design, Tips for Interviews, Empathy Interviews, Understanding and defining the problem

UNIT III

Making Sense of Observations & Insights: Observation Phase, Tips for observing, Insights definition, Problems with Insights, Case study: Insight problems in the history of aviation, Creativity process, principles and techniques, Evaluation of ideas

UNIT-IV

Developing and Testing Prototypes: Role of Prototype in design thinking, Types of prototyping, Guidelines for prototyping, Lean Startup Method for Prototype Development, Visualization and presentation techniques, Testing prototypes: Feedbacks and Maximize learning

UNIT-V

Defining & Testing Business Models & Business Cases: Business Model Definition, Design thinking to design business model, Innovation in Business Model, Pursuing innovation in business, Business model innovations cases, Kano Model, Desirability Testing.

Text Books:

1. Mueller-Roterberg, Christian. "Handbook of Design Thinking." Hochschule Ruhr West (2018).
2. Design Kit by IDEO.org. "The field guide to human centered design." (2015), ISBN: 978-0-9914063-1-9.

Suggested Reading:

1. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
2. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply", Springer, 2011
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013
4. Jeanne Liedtka , Andrew King, Kevin Bennett , “Book - Solving Problems with Design Thinking - Ten Stories of What Works” (Columbia Business School Publishing), 2013
5. Maurício Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, “Design thinking: Business Innovation” MJV Press, 2011
6. Burgelman, Christensen, and Wheelwright, “Strategic Management of Technology and Innovation”5th Edition, McGraw Hill Publications, 2017.

Web Resources:

1. https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy
2. https://www.interaction-design.org/literature/article/stage-4-in-the-design-thinking-process-prototype
3. https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
4. https://uxplanet.org/what-are-insights-aa1f2d1b3b9c
5. https://labs.sogeti.com/using-design-thinking-to-design-business-models/
6. https://www.northeastern.edu/graduate/blog/implementing-business-model-innovation/

22ADE22

SOCIETY 5.0

(Professional Elective – I)

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

Course Objectives:

1. To understand society 5.0, Cyberspace and Physical Space to solve real world issues.
2. To provide knowledge and overview about big data, IoT and Artificial Intelligence for Society 5.0.
3. Discuss to understand Augmented Reality and Virtual Reality, Next Generation Sensors.
4. To discuss Challenges and Technologies towards Society 5.0, Security of Cyber Physical Systems.
5. Discuss to apply society 5.0 Innovation with Future Trends with Applications.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the Social Problems by a System That Highly Integrates Cyberspace and Physical Space to solve real world issues.
2. Apply Internet and IoT, Big data for production lines to be adaptive, intelligent, and flexible enough to meet the updated requests
3. Develop Skills to get High Degree of Convergence between Cyberspace (Virtual Space) And Physical Spaces (Real Space)
4. Develop skills for Economic Development and a Human-Centered Society that balances economic Advancement.
5. Apply Emerging Technologies in Health-Care, Agriculture, Food Products, and Disaster Prevention.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	2	1	
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	1	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2		1
CO4	3	3	2	2	-	-	-	-	-	-	-	2	2	1	
CO5	3	3	2	2	-	-	-	-	-	-	-	2	2	1	2
CO6	3	3	2	2	-	-	-	-	-	-	-	2	2	1	

UNIT I

Introduction To Society 5.0: Introduction, Schema of society 5.0, Characteristics of Society 5.0.
Introduction to communication technologies: Artificial Intelligence, robotics, 3D Printing. People: Centric Society , Knowledge Sharing, Physical space, Cyberspace, Humanity VS Society 5.0, Elements of Society 5.0, Data Driven to Society, Modeling real world Issues.

UNIT II

Emerging Technologies With Society 5.0 : Introduction to Big Data, Issues and Challenges in the traditional systems, Intelligent Data Analysis, Big Data Storage Statistical Concepts: Sampling Distributions, Re Sampling, Prediction Error, Random Sampling, Artificial Intelligence, Foundations of AI, Intelligent agent : Types of agents, Structure, Problem solving agents, Internet of Things: Introduction to IoT, Basic Architecture of an IoT, From M2M to IoT, M2M towards IoT Robotics: Robotics system components, Robot classification Coordinate frames , degree of freedom, dynamic stabilization of robots.

UNIT III

Introduction to Industry 4.0: Introduction, Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Cyber Physical Systems and Next Generation Sensors, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, An emerging industrial structure for IoT, Cyber security in Industry 4.0, Basics of Industrial IoT, Common Issues in Industry 4.0 and Society 5.0.

UNIT IV

Challenges And Technologies Towards Society 5.0 : Overcome with Economic Development and Solution to Social Problems in Society 5.0, Security of Cyber Physical Systems: Embedded and CPS security, attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter measures, security protocols, Social Issues in Society 5.0, human centered society (Society 5.0), Sustainable Development Goals, Economic Advancement, Resolution to Social Problems.

UNIT V

Innovation with Future Trends with Applications: Mobility, Health Care, Agriculture, Food Products, Disaster Prevention.

Text Books:

1. Society 5.0 A People –Centric Super –Smart Society, Hitachi –Utokyo Laboratory, Springer, 2020.
2. Society 5.0 Industy of the Future Technologies Methods and Tools By Bruno Salgues,Willey, 2018
3. Stuart J.Russel, Peter Norvig, “Artificial Intelligence a Modern Approach”, 3rd Edition, Pearson Education, 2009.

Suggested Reading:

1. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi, 2012.
2. McKerrow P.J. “Introduction to Robotics”, Addison Wesley, USA, 1991.

Web Resources:

1. https://www.researchgate.net/publication/371672351_Innovations_in_technology_and_practices_for_ensuring_food_security
1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCSA3091.pdf

22MTC17

STOCHASTIC PROCESS AND QUEUEING THEORY 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. Learn methods to solve problems related probability functions.
2. Know characterizing a random phenomenon.
3. Identify the tools for interpreting the bivariate data
4. Know the statistical techniques to study random process
5. Able Analyze the queueing models

Course Outcomes:

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

1. Interpret the plots of statistical averages
2. Compute the measures of variation for stochastic data
3. Characterize the bivariate probability distribution of averages
4. Analyze the probabilities using probability functions.
5. Analyze the queuing behaviour of different queuing models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	3	1	-	-	-	-	-	-	-	2
CO 2	3	2	3	1	-	-	-	-	-	-	-	2
CO 3	3	2	3	1	-	-	-	-	-	-	-	2
CO 4	3	2	3	1	-	-	-	-	-	-	-	2
CO 5	3	2	3	1	-	-	-	-	-	-	-	2

LIST OF EXPERIMENTS:

1. Write a Program to create Graphs and Charts
2. Write a Program to calculate measures of Central Tendency for the data
3. Write a Program to compute Measures of Dispersion for the data
4. Write a Program for Correlation and Covariance using Pearson method
5. Write a Program for calculating Marginal functions for Bivariate Probability Distribution
6. Write a program for calculating Conditional Probability function for Bivariate Probability Distribution
7. Write a Program to compute Probabilities using Poisson Distribution
8. Write a Program to compute probabilities using Normal Distribution
9. Write a program to compute probabilities using Exponential Distribution
10. Write a Program for plotting Bivariate Gaussian Function
11. Write a Program for Creating a Queueing Model

Text Books:

1. S.R.Mani Sekhar, Dr. T.V. Suresh Kumar, “Programming with R” CENGAGE Publishers, 2017.

2. K.G.Srinivasa, G.M.Siddesh, “Statistical Programming in R”, Oxford University Press, 2017.
3. Jared P Lander, “R for Everyone” Pearson.2018.

Web Resources:

1. http://www.cyclismo.org/tutorial/R/

22CSC34N

DESIGN AND ANALYSIS OF ALGORITHMS LAB

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

Pre-Requisites: Programming and Problem Solving, Basics of Data structures and algorithms lab and Object Oriented Programming.

Course Objectives:

This course aims to:

1. Design and construct simple programs by using the different design strategies for solving different problems.
2. To enhance programming skills while improving their practical knowledge in implementing the algorithms.
3. To strengthen the practical ability and to apply suitable algorithmic approaches for solving real time problems.

Course Outcomes:

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

1. Implement greedy, dynamic programming, backtracking and branch and bound techniques.
2. Demonstrate various algorithmic design techniques.
3. Analyze the performance of various algorithms.
4. Compare various design strategies.
5. Formulate solutions to solve real world problems use acquired knowledge.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	1	1	-	-	-	-	-	-	-	1	1	
CO 2	2	2	1	2	1	-	-	-	-	-	-	-	1	2	
CO 3	2	3	1	1	3	-	-	-	-	-	-	-	2	1	
CO 4	2	2	1	1	3	-	-	-	-	-	-	-	1	1	
CO 5	2	2	1	-	2	-	-	-	-	-	-	-	1		

List of Experiments:

1. Implement problems on Divide and Conquer-Minimum-Maximum Problem
2. Implement Fractional Knapsack using greedy approach
3. Implement Job scheduling with deadlines using greedy approach
4. Implement 0/1 Knapsack using dynamic programming
5. Implement Longest Common subsequence using dynamic programming
6. Implement n-queens problem using backtracking
7. Implement graph coloring problem using backtracking
8. Implement Hamiltonian Cycle using backtracking
9. Implement bi-connected components and strongly connected components
10. Implement Dijkstra's, Bellman-Ford, Floyd-Warshall

Text Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press/McGraw-Hill, 2022.

2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis, and Internet Examples", 2nd Edition, Wiley, 2001.

Web Resources:

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

22ADC02

MACHINE LEARNING 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. 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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	2	1	-	-	-	-	-	-	-	1	2	3
CO 2	1	1	-	2	1	-	-	-	-	-	-	-	2	2	3
CO 3	2	1	1	2	2	-	-	-	-	-	-	-	2	2	3
CO 4	1	2	1	2	1	-	-	-	-	-	-	-	2	2	3
CO 5	2	1	-	2	1	-	-	-	-	-	-	-	2	2	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. Data Reduction Using Feature Extraction, Feature Selection, PCA
4. Linear Regression, Nonlinear Regression, Ridge Regression, Esso Regression, Logistic Regression
5. Decision Trees and Random Forest
6. K-Nearest Neighbor Classifiers with different similarity Measures
7. Support Vector Machines for Classification and Regression
8. Naive Bayes classifier for continuous and discrete datasets
9. Clustering using K-Means, DBSCAN
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

22ADC04

LINUX AND LATEX 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. Understand the purpose and nature of LaTeX, user interface of LaTeX
2. Understand how LaTeX differs from a word processor, format text in various ways
3. Learn how to use LaTeX to format mathematical equations.
4. Recognize, understand, and make use of various UNIX commands
5. Gain hands on experience of UNIX commands and shell programs.

Course Outcomes:
After the completion of this course, the student will be able to:
1. Run various UNIX commands on a standard UNIX/LINUX Operating system
2. Understand the shell programming on UNIX OS
3. Typing of text including roman letters, alphabets, special symbols and mathematical symbols in LaTeX.
4. Display of equations in LaTeX.
5. Creating a table and drawing a figure in LateX

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	-	-	-	2	1	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	2	1	-	-	-	-	-	-	-	2	-
CO 3	3	-	-	-	3	1	-	-	-	-	-	-	-	1	-
CO 4	3	-	-	-	3	1	-	-	-	-	-	-	-	1	1
CO 5	3	-	-	-	3	1	-	-	-	-	-	-	-	-	1

List of Programs:-
LINUX LAB:
1. Use of basic Unix Shell Commands: ls, mkdir, rmdir, cd, cat, banner, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit.
2. Commands related to inode, I/O redirection, piping, process control commands, mails.
3. Shell Programming: shell script exercise based on following:
   a. Interactive shell script
   b. Positional parameters
   c. Arithmetic
   d. If-then-fi, if-then-else-fi, nested if-else
   e. Logical operators
   f. Else + if equals elif, case structure
   g. While, for loop
   h. Meta characters
4. Write a shell script to change date format. Show the time taken in execution of this script
5. Write a shell script to count lines, words & characters in its input. (do not use wc)

LATEX LAB:

1. Introduction and basics of LaTeX.
2. Document structure and text formatting in LaTeX.
3. To Create Special Pages: Indexing, Glossary, Bibliography
4. To Create Special Documents: Letters, Presentations, Curriculum Vitae.
5. Creating Graphics in LaTeX.
6. Programming: Macros, Plain text, Creating Packages, Themes.
7. Miscellaneous: Modular Documents, Collaborative Writing of LaTeX Documents, Export to other Formats.

Text Books:

1. Behrouz A. Forouzan, Richard F. Gilberg,"Unix and shell Programming.", Cengage Learning.
2. Lamport, Leslie (1994). LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.	22CAC15	Artificial Intelligence	3	-	3	40	60	3
2.	22ADC09	Introduction to Data Science	3	-	3	40	60	3
3.	22CSC21	Software Engineering	3	-	3	40	60	3
4.	22ITC08	Enterprise Application Development	3	-	3	40	60	3
5.	22ITC10	Computer Networks	3	-	3	40	60	3
6.		Professional Elective – 2	3	-	3	40	60	3
PRACTICAL								
7.	22CAC16	Artificial Intelligence Lab	-	2	3	50	50	1
8.	22ADC10	Introduction to Data Science Lab	-	2	3	50	50	1
9.	22ADC11	Mini Project	-	2	-	100	-	2
10.	22ITC16	Competitive Coding		2	-	50	-	1
			18	**8**	**24**	**490**	**460**	**23**
Clock Hours Per Week: 24								

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

Professional Elective #2	Blockchain Technology (22CIE53)	Cyber Security (22CIE55)	Applied Predictive Analytics (22ADE23)	Automata and Compiler Design (22CAE22)	Extended Reality (22CIE15)

22CAC15

ARTIFICIAL INTELLIGENCE

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

Pre-Requisites: Data structures, Discrete Mathematics.

Course Objectives: The objectives of this course are,

1. To become familiar with basic principles of AI and its fundamentals.
2. To discuss the knowledge and application of intelligent systems and their practical applications.
3. To analyze the various knowledge representation schemes, reasoning and learning techniques of AI.

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

1. Define the role of agents and interaction with the environment to establish goals.
2. Identify and formulate search strategies to solve problems by applying suitable search strategy.
3. Understand probabilistic reasoning and Markov decision process to solve real world problems.
4. Design applications using Reinforcement Learning.
5. Apply AI concepts to solve the real-world problems.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	POS1	POS2	POS3
CO1	3	2	2	1	-	-	-	1	1	-	-	2	2	3	2
CO2	3	3	2	1	-	-	1	1	1	1	-	2	3	3	3
CO3	3	3	2	1	-	-	1	1	2	1	-	2	3	3	3
CO4	3	3	2	2	-	-	1	1	2	2	-	2	3	3	3
CO5	3	3	2	2	-	-	1	1	2	2	-	2	3	3	3

UNIT - I

Introduction: The Foundation of AI, The History of AI, The State of art.**Intelligent agents**: Agent and Environments, Good Behavior, Nature of Environments, Structure of Agents

UNIT - II

Search Algorithms: State space representation, Search graph and Search tree. Random search, Search with closed and open list, Depth first and Breadth first search. Heuristic search, Best first search. A* algorithm, problem reduction, constraint satisfaction, Game Search, minmax algorithm, alpha beta pruning, constraint satisfaction problems.

UNIT - III

Knowledge & Reasoning: Knowledge-Based Logic Agents, Logic, First-Order Logic, Syntax-Semantics in FOL, Simple usage, Inference Procedure, Inference in FOL, Reduction, Inference Rules, Forward Chaining, Backward Chaining, Resolution.

UNIT - IV

Probabilistic Reasoning: Representing knowledge in an Uncertain Domain, The semantics of Bayesian networks, efficient representation of conditional distribution, Inference in Bayesian Networks, Inference in Temporal Models, Hidden Markov models. **Markov Decision Process:** MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

UNIT - V

Reinforcement Learning: Introduction**,** Passive reinforcement learning, Active Reinforcement Learning, Generalization in reinforcement learning, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Ed., Prentice Hall, 2010.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2018.

Suggested Reading:

1. Trivedi M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi, 2018.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu

22ADC09

INTRODUCTION TO DATA SCIENCE (R Programming)

Instruction	3L 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. 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. Explore data operations on files and databases using R programming.
2. Understand deployment of models on different datasets.
3. Apply supervised, unsupervised, ensembling and NLP models on different datasets.
4. Perform Sentiment analysis.
5. Build and evaluate the models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	2	-	1	-	-	-	-	1	3	-	-
CO 2	3	3	2	3	2	-	1	-	-	-	-	1	3	-	-
CO 3	3	3	2	3	3	-	1	-	-	-	1	1	3	3	2
CO 4	3	3	2	3	3	-	1	1	-	-	1	1	3	3	2
CO 5	3	3	3	3	3	-	1	-	-	-	1	1	3	3	2

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.

Text Books:

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
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

22CSC21

SOFTWARE ENGINEERING

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

Pre-Requisites: 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.

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	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	2	2	2	3	3	3	2	3	2	3	2
CO 2	3	2	2	3	2	3	3	3	3	3	2	3	3	3	2
CO 3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	2
CO 4	3	3	3	2	3	3	3	3	3	3	3	3	3	3	2
CO 5	3	2	3	3	3	3	2	3	3	3	3	3	2	3	3

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

Design Concepts: Flow-oriented modelling (DFDs), Coupling, Cohesion, Function-Oriented Design - Structure Charts, Structured Design Methodology, An Example, 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.

Text Books:

1. Roger S. Pressman "Software Engineering: A practitioner's approach", McGraw Hill, 7th Edition, 2010.
2. Pankaj Jalote, "Software Engineering Precise Approach", Wiley Publishers, 2012

Suggested Reading:

1. Sommerville "Software Engineering", 10th Edition, Pearson, 2016.
2. Rajib Mal "Fundamental of Software Engineering", 4th Edition, PHI Learning, 2014.
3. Software Engineering Fundamentals - Hardcover - Ali Behforooz; Frederick J. Hudson

Web Resources:

1. https://nptel.ac.in/courses/106101061/
2. Udemy:https://www.udemy.com/share/101BHy3@YYJn8BxwvS6cGfnCsiIlxyA-lUjwZmA2xN5WmMbd8hlGxwhc4N0DF7KaEOaz4eDnMg==/

22ITC08

ENTERPRISE APPLICATION DEVELOPMENT

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

Course Objectives:

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

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	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	-	-	-	-	-	-	-	-	1	2	3
CO2	2	2	3	3	3	2	2	2	-	1	-	2	2	2	1
CO3	2	3	3	3	3	2	2	2	-	1	-	2	1	2	1
CO4	2	3	3	3	3	2	2	2	-	1	-	2	3	2	1
CO5	2	2	2	3	3	-	-	-	-	-	-	1	1	3	2

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.**edux and MUI:** Introduction to Redux, State, Actions, Reducers, Color

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 Sharding.

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/

22ITC10

COMPUTER NETWORKS

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

Course Objectives:

1. To understand the basics of Layering Concepts, Physical layer, data transmission, transmission media.
2. To demonstrate the state-of-the-art knowledge on Data Link Layer Concepts.
3. To distinguish the different types of networks and Network Layer in the Internet.
4. To introduce Transport Layer basics, UDP and TCP Protocols.
5. To understand the concepts of Application Layer Protocols.

Course Outcomes:

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

1. Illustrate the functions of each layer in the OSI and TCP/IP reference models and demonstrate the concepts of Physical Layer.
2. Analyze the Data Link Layer protocols and MAC mechanisms.
3. Evaluate the Network Layer Issues and to avoid Congestion in Networks.
4. Exemplify 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	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	1	2	1
CO2	3	2	1	1	1	-	-	-	-	-	-	1	1	2	1
CO3	3	2	1	1	1	-	-	-	-	-	-	1	1	2	1
CO4	3	2	1	2	1	-	-	-	-	-	-	1	1	2	1
CO5	2	2	1	2	1	-	-	1	-	-	-	1	1	2	1

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, Basics of Packet Switching, Circuit Switching and Virtual Circuit switching, Models. **Physical Layer**: Guided Transmission media: twisted pairs, coaxial cable, fiber optics, Wireless transmission.

UNIT-II

Data Link Layer: Design issues, Framing, Error detection and correction, Elementary data link protocols: simplex protocol, A Simplex Stop and Wait Protocol for an Error-free channel, A Simplex Stop and Wait Protocol for Noisy Channel, Sliding Window protocols: A One-Bit Sliding Window Protocol, A protocol using Go-Back-N, A Protocol using Selective Repeat, Example data link protocols, Medium Access Sub Layer: The Channel allocation problem, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Collision Free Protocols, Ethernet.

UNIT III

Network Layer: Design issues, Routing algorithms: The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, OSPF, BGP. Congestion Control Algorithms, Quality of Service, Internetworking, The Network layer in the Internet- The IP Version

4 Protocol, Fragmentation and IP Addresses, CIDR Notation, IP Version 6, Internet Control Protocols. Basics of IP Support Protocols (ARP/RARP, DHCP, ICMP) Network Address translation (NAT)

UNIT-IV

Transport Layer: Transport Service- Transport service primitives, Berkeley Sockets, TCP/ UD Sockets, Elements of Transport protocols, The Internet Transport Protocols: UDP, TCP - Introduction to UDP, Real Time Transport Protocols, Introduction to TCP, The TCP Service Model, 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. **The World Wide Web** - Architectural Overview. Streaming Audio and Video: Streaming Stored Media, Streaming Live Media. Content Delivery.

Text Books:

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

Suggested Reading:

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

Web Resources:

1. https://nptel.ac.in/courses/117105148
2. https://www.ibm.com/docs/en/i/7.1?topic=communications-socket-programming
3. Web Resources for Computer Networks, 5 (vu.nl)

22CIE53

BLOCKCHAIN TECHNOLOGY

(Professional Elective -II)

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

Course Objectives:

1. To get acquainted with the foundations of Bockchain.
2. To provide the significance of the bitcoin ecosystem.
3. To explore the consensus mechanisms and technologies that support ethereum.
4. To introduce Hyperledger Fabric and its architecture.
5. To familiarize Blockchain use cases in various domains.

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

1. Define distributed systems and blockchain
2. Explain the concepts of bitcoin and consensus mechanisms in bitcoin mining.
3. Explore the consensus mechanisms and technologies that support Ethereum.
4. Describe Hyperledger Fabric architecture and Hyperledger Projects.
5. Analyse blockchain use cases in various domains.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	3	-	1	-	-	1	-	1	3	1	2
CO 2	3	3	2	1	3	-	2	-	-	2	-	1	3	2	3
CO 3	3	3	2	1	3	-	2	-	-	1	-	2	3	3	3
CO 4	3	3	2	2	2	-	1	-	-	2	-	2	2	3	2
CO 5	3	3	2	2	3	-	2	-	-	2	-	1	3	3	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- Namecoin, 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

Case studies using Blockchain: Cross border payments, Know Your Customer (KYC), Food supplychain, Mortgage over Blockchain, Identity on Blockchain, Blockchain in Insurance Industry, Education, Healthcare, realestate management and Metaverse

Text Books:

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 Implementations”, APress Publishing, 2024

Web 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:
    a. Blockchain and its Applications,
    b. Blockchain Architecture Design and Use Cases

22CIE55

CYBER SECURITY

(Professional Elective -II)

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

Pre-Requisites:

A foundational understanding of computer science principles, basic programming skills, knowledge of operating systems, familiarity with network fundamentals, prior coursework or experience in IT (network security, software development), and comfort with technical terminology and cybersecurity concepts.

Course Objectives:

1. Gain a comprehensive understanding of cybersecurity principles, including definitions, challenges, and human factors.
2. Analyze the origins, categories, and methods of cybercrimes, including tools and defenses.
3. Examine vulnerabilities in software platforms and operating systems, and strategies for prevention, detection, and mitigation.
4. Educate on the security requirements and risk management strategies for databases and cloud environments.
5. Introduce security concerns of cyber-physical systems (CPS) and guide on using threat intelligence tools and recovery processes.

Course Outcomes:

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

1. Understand and articulate key principles and challenges of cybersecurity, including human factors and the cybersecurity kill chain.
2. Identify and describe various categories of cybercrimes and implement appropriate tools and methods for defense.
3. Recognize, prevent, and mitigate vulnerabilities in software and operating systems, ensuring secure software lifecycle processes.
4. Understand security requirements for databases and cloud environments, employing risk analysis and security tools to protect data and services.
5. Assess security and privacy concerns of CPS, apply threat intelligence tools, and manage investigation and recovery processes following cybersecurity incidents.

CO-PO Articulation Matrix:

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	2	1
CO2	3	2	2	1	2	-	-	-	-	-	-	2	2	2	1
CO3	3	3	3	2	3	-	-	-	-	-	-	3	2	3	1
CO4	2	3	2	2	1	-	-	-	-	-	-	2	1	2	1
CO5	3	2	3	3	2	-	-	-	-	-	-	2	2	2	1

UNIT – I

Cybersecurity: Definition, Principles. **Cybersecurity challenge**s: old techniques and broader results, the shift in the threat landscape. **Cybercrime:** Definition and Origins of the word. **Cyberoffenses:** Categories of Cybercrime. **Tools and Methods Used in Cybercrime**: Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDos Attacks, SQL Injection, Buffer Overflow. **Understanding the Cybersecurity Kill Chain:** External reconnaissance, Access, and privilege escalation. **Authentication, Authorization, and Accountability (AAA):** Access control, Identity management, user authentication, and technical aspects of accountability.

UNIT – II

Software Security: Categories of Vulnerabilities, Prevention and Detection of Vulnerabilities, Mitigating Exploitation of Vulnerabilities. **Security in the Design of Operating Systems:** Simplicity of Design Layered Design Kernelized Design Reference Monitor Correctness and Completeness Secure Design Principles Trusted Systems Trusted System Functions.

UNIT – III

Web and Mobile Security: Fundamental Concepts and Approaches, Sandboxing, Client-Side and Server-Side Vulnerabilities and Mitigations. **Cybercrime: Mobile and Wireless Devices**: 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 phones**.**

UNIT – IV

Database Security: Security Requirements of Databases, Reliability, and Integrity, Database Disclosure. **Cloud Computing Security**: Introduction to Cloud Computing, Service and Deployment Models, Risk Analysis, Cloud as a Security Control, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

UNIT – V

Threat Intelligence: Introduction, Open-Source Tools, Microsoft Threat Intelligence, Leveraging Threat Intelligence to Investigate Suspicious Activity. **Investigating an Incident**: Investigating an Incident, Scoping the issue, Key artifacts, investigating a compromised system on-premises, Investigating a compromised system in a hybrid cloud. **Recovery Process**: Disaster recovery planning process, challenges. **Cyber-Physical Systems (CPS):** Characteristics, Risks, Security and Privacy Concerns.

Text Books:

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cybercrimes, Computer Forensics, and Legal Perspectives”, First Edition, Wiley India, 2011.
2. Security in Computing, Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Fifth Edition, Prentice Hall, 2018.
3. The Cyber Security Body of Knowledge, Awais Rashid, Howard Chivers, George Danezis, Emil Lupu, Andrew Martin, First Edition, 2019
4. Cybersecurity - Attack and Defense Strategies, Yuri Diogenes, Erdal Ozkaya - Third Edition, Packt Publishing, 2022.

Suggested Books:

1. Cybersecurity Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, John Wiley & Sons, Sybex A Wiley Brand, 2018
2. Network Security Assessment, Chris McNab, Third Edition, O'Reilly Media, Inc., 2016
3. Computer security: principles and practice, William Stallings, Lawrie Brown, Second Edition, Pearson Education, 2013
4. Network Security Essentials: Applications And Standards, William Stallings, Fourth Edition, Pearson Education, 2011.

Web Reference:

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

22ADE23

APPLIED PREDICTIVE ANALYTICS

(Professional Elective-II)

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 to 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	PO12	PSO1	PSO2	PSO3
CO 1	1	2	2	-	-	-	-	-	-	-	1	3	3	3	2
CO 2	2	3	1	3	2	-	-	-	-	1	1	3	3	3	2
CO 3	2	3	1	3	2	-	-	-	-	2	1	3	3	3	3
CO 4	2	3	2	3	1	-	-	-	-	2	1	3	3	3	2
CO 5	2	3	2	3	2	-	-	-	-	1	1	3	3	3	2

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.

Text Books:

1. Abbott, Dean. Applied predictive analytics: Principles and techniques for the 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_coursera-plus_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.

22CAE22

AUTOMATA AND COMPILER DESIGN

(Professional Elective-II)

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

Course Objectives:

1. Understand the central concepts of automata theory, including finite automata and their variants such as deterministic and nondeterministic finite automata.
2. Explore context-free grammars, parse trees, and pushdown automata, discerning their role in formal language theory and their equivalence with context-free grammars.
3. Analyze Turing machines and their relation to computability, recognizing the significance of undecidable problems in theoretical computer science.
4. Familiarize with the structure of a compiler and its phases, with a specific emphasis on lexical analysis and syntax analysis techniques.
5. Understand syntax-directed translation and its applications, including the generation of intermediate code and syntax-directed translation schemes.
6. Gain proficiency in designing run-time environments and mastering code generation principles. They'll also acquire knowledge of machine-independent optimizations, equipping them to design efficient compilers and runtime systems.

Course Outcomes:

Upon completing this course, students will be able to:

1. Solve computational problems using finite automata and regular expressions, including pattern matching, lexical analysis, and language recognition.
2. Develop a strong understanding of context-free grammars, pushdown automata, Turing machines, and undecidability, recognizing their importance in theoretical computer science and computational modeling.
3. Gain skills in designing and constructing compilers, focusing on lexical analysis, syntax analysis, and top-down parsing, to translate source code into executable machine instructions.
4. Master bottom-up parsing, syntax-directed translation, and intermediate-code generation to design and implement sophisticated compilers for translating high-level programming languages.
5. Learn run-time environment management, code generation, and machine-independent optimizations to design and implement high-performance compilers that generate efficient machine code across various architectures.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	-	-	-	-	-	2	-	1	-	2	2	2
CO 2	3	-	-	3	3	-	2	-	-	-	-	-	2	2	2
CO 3	-	3	3	-	-	2	-	3	-	-	-	-	2	2	2
CO 4	-	-	3	3	-	2	-	-	-	1	-	-	2	2	2
CO 5	-	-	3	3	-	-	-	-	-	1	1	-	2	3	2

UNIT-I

Automata: Introduction, The Central Concepts of Automata Theory, Chomsky Hierarchy of languages. **Finite Automata:** Definition, Applications, Deterministic Finite Automata (DFA),

Nondeterministic Finite Automata (NFA) – Equivalence of Deterministic and Nondeterministic Finite Automata, Finite Automata with Epsilon-Transitions- Eliminating Epsilon-Transitions. **Regular Expressions and Languages:** Definition, applications; Finite Automata and Regular Expressions – Converting Regular Expressions to Automata, Converting DFA's to Regular Expressions. Properties of Regular Languages - Pumping Lemma, Closure Properties and Decision Properties.

UNIT-II

Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages. **Pushdown Automata (PDA):** Definition, Languages of a PDA, Equivalent of PDA's and CFG's, Deterministic Pushdown Automata (DPDA). **Introduction to Turing Machines:** Turing Machines and Languages, Types of Turing Machine, Turing Machines and Computers. **Undecidability:** Undecidable Problems about Turing Machines, Post's Correspondence Problem.

UNIT-III

Introduction to Compilers: The structure of a compiler – Phases of compiler. **Lexical Analysis:** The Role of the Lexical Analyzer, Specification and Recognition of Tokens, The Lexical-Analyzer Generator Lex.**Syntax Analysis / Parsing:** Introduction, Context-Free Grammars, Writing a Grammar**. Top-Down Parsing:** Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing.

UNIT-IV

Bottom-Up Parsing: Reductions, Handle Pruning, Shift-Reduce Parsing, Introduction to LR Parsing - Simple LR, More Powerful LR Parsers - CLR Parser and LALR Parser. Parser Generators - Yacc**Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes. **Intermediate-Code Generation:** Variants of Syntax Trees, Three-Address Code, Types and Declarations, Type Checking.

UNIT-V

Run-Time Environments: Storage Organization, Stack Allocation of Space, Heap Management.**Code Generation**: Issues in the Design of a Code Generator; Basic Blocks and Flow Graphs; Optimization of Basic Blocks; A Simple Code Generator; Peephole Optimization.**Machine-Independent Optimizations:** The Principal Sources of Optimization; Introduction to Data-Flow Analysis- liveness analysis; Constant Propagation; Partial Redundancy Elimination.

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
7. Compiler Design, IIT Madras
   https://nptel.ac.in/courses/106106237
8. NOC: Compiler Design, IIT Kharagpur
   https://nptel.ac.in/courses/106105190

22CIE15

Extended Reality

(Professional Elective-II)

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

Pre-Requisites:

Basic knowledge on computer hardware and software components.

Course Objectives:

1. To understand immersive technology current state of development for designing and developing immersive experiences.
2. To understand the sensory, emotional and narrative immersion for best practice user interface and experience design.
3. To understand the intersection of AI and VR/XR, looking at how AI is being used to improve everything from graphics rendering to user interaction.
4. To understand the applications of VR/XR in healthcare, discussing the latest research, challenges and opportunities for healthcare professionals.
5. To understand the design principles that guide the creation of immersive experiences, from 3D modelling to user interface design.

Course Outcomes:

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

1. Define and explain principles in immersive technology for designing and developing immersive experiences.
2. Explain the sensory, emotional and narrative immersion for best practice user interface and experience design.
3. Model and create intersection of AI and VR/XR to user interaction.
4. Design the applications of VR/XR in healthcare, discussing the latest research, challenges and opportunities for healthcare professionals.
5. Choose the creation of immersive experiences, from 3D modelling to user interface design.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	-	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	2	-	-	-	-	-	-	3	2	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	2	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	2	3

UNIT – I

Immersive Technology: Introduction Promise and Potential, Knowing immersive technologies - AR/VR/ExR, Overview of immersive technologies, AR/VR Milestones and breakthroughs, Current state, Statistical data, Potential and Limitations of immersive technologies. **The Psychology of Presence in**

Immersive Technologies- Knowing presence, Theories of presence, Factors contributing to presence, Measuring, Advantages and limitations of measuring presence and Application of presence.

UNIT-II

Designing Immersive Experience - Introduction, designing for sensory immersion, Designing for emotional immersion, Designing for narrative immersion, Best practices for user interface and experience design. **Evolution of VR Hardware -** Introduction to virtual reality hardware, The rise of consumer virtual reality, Virtual reality hardware design challenges, The future of virtual reality hardware, Role of haptic feedback on virtual reality hardware, Types of haptic feedback, Benefits and limitations of haptic technology, Case studies

UNIT – III

AI in AR/VR/XR: -Introduction, AI and its usage in VR/AR, Graphic rendering, Natural language processing, User interaction, Predictive analytics. **Business Landscape of AR/VR/XR-** Introduction, Funding and investment, Funding and its challenges for VR/XR industry, Monetization strategies, User adoption and marketing, Technology challenges, Case studies.

UNIT – IV

Applications of AR/VR/XR in Healthcare: -Introduction, Diagnosis and treatment, Rehabilitation and physical therapy Medical education and training, Use of immersive technology in patient education and engagement, Case studies, Design principles, Medical realities. **Applications of AR/VR/XR in Education:** Introduction, Immersive learning environment, Simulations and training, Personalized learning, Collaborative learning, Case studies.

UNIT – V

Ethics in Immersive Technologies: Introduction to ethics in immersive technologies, Safety and physical health Psychological and emotional impact, Case studies. **3D Modeling and User Interface Design:** Introduction to 3D modelling, Modelling technique, Artistic and technical balance, Real-time 3D and game engines, User interface design principles, User interface design software and workflow, Implementing UIs in 3D environment, **Case Study:** Building VR Applications with Unity.

Text Book:

1. Immersive Realm of Extended Reality, Author Suman Dutta, First Edition 2024, Copyright © BPB Publications, India, ISBN: 978-93-55517-227

Suggested Books:

1. VIRTUAL REALITY, Steven M. LaValle, University of Oulu, Cambridge University Press.
2. Virtual and Augmented Reality- An Educational Handbook, By Zeynep Tacgin, Cambridge Scholars Publishing Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK
3. Virtual Reality Technology, Grigore C. Burdea, Philippe Coiffet, John Wiley & Sons, 30 Jun 2003 - Computers - 464 pages
4. 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:

1. https://axisxr.gg/the-future-of-xr-trends-to-look-for-in-2024/
2. https://www.interaction-design.org/literature/topics/extended-reality-xr
3. https://www.accenture.com/us-en/services/technology/extended-reality
4. https://www.sngular.com/insights/235/extended-reality-will-it-be-more-widespread-in-2024.

22CAC16

ARTIFICIAL INTELLIGENCE LAB

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

Course Objectives:

The objectives of this course are:

1. To design and analyse various computing algorithms and techniques using Python.
2. To apply different learning algorithms to solve real time problems.
3. To recognize the underlying mathematical models and logics behind various AI techniques.

Course Outcomes:

On Successful completion of this course, student will be able to

1. Understand the basic components of library environment and installations.
2. Analyse the design heuristics and apply various techniques to solve real world problems.
3. Apply variety of algorithms to solve problems.
4. Analyse the design the Hidden Markov Model (HMM).
5. Implement problems using game search algorithms.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	-	1	1	2	2	1	1	2	1	2	2
CO2	1	3	3	2	-	2	2	2	2	2	2	2	3	3	3
CO3	1	2	2	3	-	2	2	2	3	2	3	2	3	3	3
CO4	1	3	3	2	-	2	2	2	2	2	2	2	2	3	3
CO5	1	2	2	3	-	2	2	2	2	3	3	2	3	3	3

List of Experiments:

1. Explore the Libraries TensorFlow/Keras, DEAP, NumPy, pandas ,PyTorch, Scikit-Learn and Matplotlib.
2. Understanding Anaconda Navigator and Environment Setup.
3. Design/construct the workflow of a general AI project using draw.io
4. Implement Water Jug Problem using A* search
5. Implement an 8-puzzle solver using Heuristic search technique.
6. Implement the Constraint Satisfaction problem using backtracking.
7. Implement a program for game search.
8. Implement a Bayesian network from a given data and infer the data from that Bayesian network.
9. Implementing a Hidden Markov Model (HMM) for a Simple Application.
10. Implement a MDP to run value and policy iteration in any environment.

Text Books / Suggested Reading:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall,2010.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition, 2017.

Web Resources:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu
4. https://ai.berkeley,edu/project_overview.htm

22ADC10

INTRODUCTION TO DATA SCIENCE LAB ('R' Programming)

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 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 appropriate data structures for storing and processing the data.
2. Choose suitable data type to handle real time data and explain file formats.
3. Apply preprocessing techniques on raw data.
4. Interpret the data from visualizations.
5. Build supervised and unsupervised models to solve real world problems.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	2	-	1	-	-	1	-	1	3	2	3
CO 2	3	3	2	3	2	3	1	-	-	2	-	1	3	2	3
CO 3	3	3	2	3	3	-	1	-	-	1	1	1	3	3	2
CO 4	3	3	2	3	3	2	1	1	-	3	1	1	3	3	2
CO 5	3	3	3	3	3	3	1	-	-	3	1	1	3	3	2

List of programs:
1. Implementation of R program to create a list containing numbers, vectors, and logical values., Strings.
2. Demonstrate the usage of R data structures. (List, Tuples, Sets, Dictionaries, Strings, Factors)
3. Implement file handling operations in R for various file formats.
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 a test data and predict the numerical quantities.
8. Demonstrate Association rule Technique.
9. Explore text mining techniques and sentiment analysis.

Text Books:

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

22ADC11 **MINI PROJECT**

Instruction	2P Hours per week
CIE	100 Marks
Credits	2

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse 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, Analyse, 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	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	2	1	2	3	3	2	3	2
CO2	3	3	3	3	3	3	3	2	1	2	3	3	1	3	2
CO3	3	3	3	3	3	3	3	2	-	2	3	3	3	3	2
CO4	2	2	2	3	3	3	3	2	3	3	2	3	2	3	2
CO5	1	2	1	2	3	3	-	-	2	3	-	-	2	3	-

The Students are required to choose a topic for mini project related to the courses of the current semester or previous semester. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to 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	40
2.	PPT Preparation	10
3.	Presentation	20
4.	Question and Answers	10
5.	Report Preparation	20

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.

22ITC16

COMPETITIVE CODING

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

Course Objectives:

1. Learn to solve different kinds of puzzles and problems.
2. Understand basic algorithms and how to use them to solve problems.
3. Improve your coding skills in programming languages like C++ / Python / Java.
4. Learn to collaborate with others while also trying to do your best.
5. Learn what you need to do to do well in programming contests.

Course Outcomes:

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

1. Demonstrate comprehension of complex problems and develop algorithmic solutions to address them effectively.
2. Apply various data structures and algorithms to solve computational problems efficiently.
3. Evaluate and optimize code performance by applying advanced algorithmic optimizations and runtime analysis techniques.
4. Explain problem-solving approaches, algorithms, and implementations clearly and concisely, fostering effective communication within the programming community.
5. Utilise techniques and strategies to solve competitive programming challenges, resulting in improved contest performance

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	1	-	-	-	-	-	-	1	2	2	2
CO2	2	3	2	-	1	-	-	-	-	-	-	1	2	2	2
CO3	2	3	2	-	1	-	-	-	-	-	-	1	2	2	2
CO4	2	3	2	-	-	-	-	-	-	-	-	1	2	2	2
CO5	2	3	2	-	1	-	-	-	-	-	-	1	3	2	3

Prerequisites:

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

Week 1-2: Introduction to Competitive Coding

1. **Session 1 :**
   - Overview of Competitive Coding
   - Setting up the development environment (IDEs, online judges)
   - Introduction to basic data structures (arrays, linked lists, functions, recursion)
2. **Session 2 :**
   - Basic programming constructs in competitive coding
   - Time complexity and Big O notation

Week 3-4: Algorithms and Problem Solving

3. **Session 3 :**
   - Introduction to sorting algorithms (bubble, insertion, selection)
   - Practice problems on sortings
   - Searching algorithms (linear search, binary search)

- Practice problems on searchings

4. **Session 4 :**
   - Bit manipulations
   - Practice problems on Bit manipulations

Week 5-6: Data Structures

5. **Session 5 :**
   - Stacks and Queues
   - Practice problems on stack and queue implementations
6. **Session 6 :**
   - Introduction to trees and graphs
   - Basic graph traversal algorithms (DFS, BFS)

Week 7-8: Backtracking

7. **Session 7 :**
   - Introduction to backtracking
   - Basic backtracking algorithms
   - Practice problems on backtracking
8. **Session 10:**
   - Advanced backtracking techniques
   - Practice problems on advanced backtracking

Week 9-10: Dynamic Programming

9. **Session 9 :**
   - Introduction to dynamic programming
   - Top-down and bottom-up approaches
   - Fibonacci series as a DP problem
10. **Session 10 :**
    - Practice problems on dynamic programming

Week 11-12: Advanced Algorithms

11. **Session 11 :**
    - Greedy algorithms
    - Practice problems on greedy algorithms
12. **Session 12:**
    - Divide and conquer algorithms
    - Practice problems on divide and conquer

Week 13-14: Advanced Data Structures

13. **Session 13 :**
    - Heaps and priority queues
    - Practice problems on heaps
14. **Session 14 :**
    - Hashing and advanced topics in trees and graphs
    - Practice problems on hashing

Practice Platforms:

Regularly practice problems on online coding platforms like Codeforces, HackerRank, CodeChef, and LeetCode.

Contest Simulation: Participate in virtual contests to simulate real competitive coding environments.

Competitive Programming 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/edit#gid=0
7. https://docs.google.com/spreadsheets/d/1kyHfGGaLTzWspcqMUUS5Httmip7t8LJB0P-uPrRLGos/edit#gid=0

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2023-24)

B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.	22ADC12	Big Data Analytics	3	-	3	40	60	3
2.	22CAC04	Deep Learning	3	-	3	40	60	3
3.	22CIC07	Industrial Internet of Things Systems	3	-	3	40	60	3
4.	22ITC29	Cloud Computing	3	-	3	40	60	3
5.		Professional Elective – 3	3	-	3	40	60	3
6.		Open Elective – 1	3	-	3	40	60	3
PRACTICAL								
7.	22ADC13	Big Data Analytics Lab	-	2	3	50	50	1
8.	22CAC05	Deep Learning Lab	-	2	3	50	50	1
9.	22CIC08	Industrial Internet of Things Systems Lab	-	2	3	50	50	1
10.	22EGC03	Employability Skills	-	2	3	50	50	1
11.	22ADU02	Upskill Certification Course	--		-	25	-	0.5
			18	**8**	**30**	**465**	**560**	**22.5**
Clock Hours Per Week: 26								

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

Professional Elective #3	Scalable Application Development (22ITE10)	Federated Machine Learning (22ADE24)	Image and Video Analytics (22ADE25)	Software Defined Networking (22ADE26)	Unmanned Aerial Vehicles (22ITE13)

Open Elective #1	Bioterrorism and National Security (22BTO03)	Fundamentals of Quantum Computing (22MTO01)	Technical Writing Skills (22EGO01)	Optimization Techniques (22MTO02)	Organizational Behaviour (22MBO03)

22ADC12

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. Investigate the integration of Kafka with other streaming frameworks like Apache Spark and Apache Flink.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand 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. Understand the Implementation of Spark and the Scala programming.
4. Expertise in using Resilient Distributed Datasets (RDD) for creating applications in Spark and query \using Spark SQL.
5. Apply streaming technologies in real-time data processing.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	-	-	-	-	2	-	3	3	3	3
CO2	2	3	2	3	1	3	-	-	-	2	-	3	3	3	2
CO3	2	3	2	3	3	3	3	3	-	2	3	3	3	3	3
CO4	2	3	2	3	3	3	3	3	-	2	3	3	3	3	2
CO5	2	3	2	3	3	3	3	3	-	2	3	3	3	3	3

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 operations, Job execution, Spark Applications : Cluster computing with working sets. **Spark SQL:** What is SQL, Big Data and SQL: Spark SQL, Creating DataFrames, Dataframes Operations, How to Run Spark SQL Queries, Tables, Views, Databases, Select Statements.

UNIT-IV

Machine Learning with Spark: Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark. **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

Streaming: Introduction to Stream Processing, Batch processing vs. stream processing, Spark structured streaming API, use case using Spark streaming. **Apache Kafka Fundamentals:** Architecture, Brokers, Topics, Partitions, Producers, Consumers, Kafka Connect and Kafka Streams. **Advanced Kafka Features:** xactly-Once Semantics, Kafka Transactions, Tiered Storage, Integrating Kafka with Apache Spark and Apache Flink, Integrating Kafka with Spark Streaming, Real-time Analytics Use Cases with Kafka such as Fraud Detection, Clickstream Analysis, Real-time Monitoring.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018.
3. Anand Rajaraman and Jeffrey David Ullman,”Mining of Massive Datasets”,2nd Edition,Cambridge University Press, 2014.
4. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017
5. Viktor Gamov, "Kafka Streams in Action", 1st Edition, Manning Publications, 2018

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.

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

22CAC04

DEEP LEARNING

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

Pre-Requisites: Artificial intelligence, Machine Learning

Course Objectives:
The objectives of this course are:
1. Provide students with a strong foundation in the history, concepts, and mathematical principles of deep learning.
2. Develop students' skills in gradient descent methods and regularization techniques for effective model training.
3. Equip students to design and implement convolutional and recurrent neural network architectures.
4. Enhance students' understanding and application of autoencoders and regularization methods for robust models.
5. Expose students to the latest deep learning models and trends, preparing them for future advancements.

Course Outcomes:
On Successful completion of the course, students will be able to:
1. Demonstrate comprehensive understanding of foundational deep learning concepts and neural network architectures.
2. Design and apply sophisticated neural network models to solve complex real-world problems.
3. Utilize diverse training algorithms and optimization methods to enhance deep learning model performance.
4. Implement innovative techniques for model development and regularization to improve generalization and robustness.
5. Investigate and apply recent advancements in deep learning, including transformers and GANs, to stay current in the field.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	1	1	1	1	2	2	3	3
CO2	3	3	2	2	3	1	1	1	1	1	1	2	3	3	3
CO3	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3
CO4	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3

UNIT-I
Neural Networks: History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.

UNIT-II
Backpropagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue

Decomposition. **Regularization:** Bias Variance Tradeoff, L2 regularization, early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

UNIT-III

Convolutional Neural Network: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types. **Pre-trained models:** LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.

UNIT-IV

Auto encoders: relation to PCA, Regularization in auto encoders, Denoising auto encoders, sparse auto encoders, Contractive auto encoders **Recurrent Neural Networks**: Vanishing and Exploding Gradients, GRU, LSTMs. Encoder Decoder Models, Attention Mechanism.

UNIT-V

Transformers: ViT and BERT models. **Generative Adversarial Networks (GANs):** Introduction, Discriminator, Generator, Activation, Common Activation functions for GANs**. RECENT TRENDS:** Zero-shot, One-shot, Few-shot Learning; Self-supervised Learning.

Text Books:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Rothman, Denis, "Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", Packt Publishing Ltd, 2021.
3. Ganguly Kuntal, "Learning generative adversarial networks: next-generation deep learning simplified", Packt Publishing, 2017.

Suggested Reading:

1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
5. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004. David Marr, Vision, 1982.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85/

22CIC07

INDUSTRIAL INTERNET OF THINGS SYSTEMS

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Mark
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. Illustrate working of I/O devices, sensors & communication module.
3. Analyse the use of protocols in IoT.
4. Interface I/O devices, Sensors & communication module
5. Develop real time IoT based projects.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	-	-	1	-	-	-	1	1	1	1
CO2	1	1	1	1	1	-	-	1	-	-	-	1	1	2	-
CO3	1	1	1	1	2	-	-	1	-	-	-	1	1	1	-
CO4	1	-	-	-	1	-	-	1	-	-	-	1	1	1	-
CO5	2	2	1	1	2	1	-	1	1	1	1	1	1	1	1

UNIT – I
Internet of Things: The Third Wave? Advantages and Disadvantages of IoT. **The Industrial Internet of Things (IIoT):** Definition of IIoT, IoT, and M2M, IIoT Challenges, IIoT Requirements, IIoT Benefits. **Internet of Things: More than Smart "Things":** IoT key attributes, Three Major Challenges Facing IoT: Technology, Technological Challenges, Business, Categories of IoT, Architecture of IoT.

UNIT – II
IoT Implementation and Challenges: Components of IoT Implementation: Sensors, Networks, Standards, Intelligent analysis, Intelligent actions. IoT Standardization and Implementation Challenges, Communication modules, I/O interfaces, Programming API's.

UNIT – III
Configuring Raspberry Pi, MicroPython Pyboard, and Jetson Nano for Python: Raspberry Pi Board Feature, Configuration of Raspberry Pi, Simple Applications with Raspberry Pi: OLED Display Interface, Camera Interfacing, Motor Control (DC Motor, Stepper Motor, and Servo Motor), Raspberry Pi and Mobile Interface Through Bluetooth.

UNIT – IV

IoT data protocols: MQTT, CoAP, AMQP, DDS, HTTP, WebSocket. **Network Protocols for IoT:** 6LowPAN, RPL, WiFi, Bluetooth, ZigBee, Z-Wave, LoRaWan, , XMPP.

UNIT – V

IIoT Case Studies: Smart Grids for Energy Management, Connected Agriculture, Smart Buildings and Facilities Management, Supply Chain Optimization, Connected Healthcare, Smart Retail, Smart Transportation, Water Management

Text Books:

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. ArshdeepBahga, Vijay Madisetti, Internet of Things: A hands on approach, 2014, VPT publishers

Suggested Reading:

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", O Reilly Media, 2011.

Web Reference:

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.

22ITC29

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, 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:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	1	1	1	2	3	1	3	1	2	1
CO 2	3	3	2	2	1	1	1	1	2	3	1	3	2	3	1
CO 3	3	3	2	2	1	1	1	1	2	3	1	3	2	3	1
CO 4	3	3	2	2	1	1	1	1	2	3	1	3	2	2	1
CO 5	3	3	3	2	1	1	1	1	2	3	1	3	2	3	1

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, Fundamental of 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, Metacloud 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.

Text Books:

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.

22ITE10

SCALABLE APPLICATION DEVELOPMENT

(Professional Elective –III)

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

Course Objectives:

1. To Understand the basic concepts of the Spring Framework
2. To provide basic knowledge of Web Application Development with Spring Boot and Restful APIs
3. To explore data access with Spring's DAO Module
4. To acquire Knowledge of Spring transaction management
5. To study Spring's unit testing framework and Introduce Spring Security with Rest API

Course Outcomes:

Upon completing 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	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	-	-	-	1	2	1	1	3	3	3
CO2	2	3	3	3	3	3	-	-	1	1	2	1	2	3	3
CO3	2	3	3	3	3	3	-	-	1	1	2	1	3	3	3
CO4	2	3	3	3	3	3	-	-	1	1	2	1	1	3	3
CO5	2	3	3	3	3	3	-	-	1	1	2	1	1	3	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, Autowiring using @Autowired, 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 @ResponseBody, Spring MVC's HttpMessageConverters 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 CommandLineRunner.

UNIT-IV

JDBC Simplification with JdbcTemplate: How Spring integrates with existing data access technologies, Spring‘s JdbcTemplate and DataAccessException 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.

Text Books:

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

22ADE24

FEDERATED MACHINE LEARNING

(Professional Elective-III)

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) including its motivation, definitions, and categories.
2. Familiarize with the mathematical models and algorithms underpinning FL, such as 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. Demonstrate a comprehensive understanding of the theoretical principles driving Federated Learning and its applications in privacy-preserving machine learning.
2. Apply mathematical models and algorithms to design and analyze Federated Learning systems, ensuring privacy and security of distributed data.
3. Evaluate privacy threat models and security mechanisms in FL, and propose solutions to mitigate privacy risks and enhance security.
4. Design scalable distributed machine learning schemes for Federated Learning, addressing challenges related to large-scale data and computation.
5. Critically assess advanced theoretical concepts in FL, such as federated transfer learning and federated reinforcement learning, and propose innovative solutions to address emerging challenges in distributed learning environments.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	3	-	-	-	-	-	1	-	-	2	3	1
CO 2	3	2	1	3	-	-	-	-	-	-	-	-	2	3	1
CO 3	3	2	1	3	1	-	-	-	-	-	-	-	2	3	1
CO 4	3	2	1	3	1	-	-	-	-	-	-	-	1	2	1
CO 5	3	2	1	3	1	-	-	-	-	-	-	-	1	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

Text Book:

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

22ADE25

IMAGE AND VIDEO ANALYTICS

(Professional Elective-III)

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	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2		2			2		2	2	2	1
CO2	1	2	2	2	2					2		2	2	2	1
CO3	1	2	2	2	2				2	2		2	2	2	1
CO4	1	2	2	2	2					2		2	2	2	1
CO5	1	2	2	2	2					2	3	3	3	3	3

UNIT - I

INTRODUCTION

Computer Vision – Image representation and image analysis tasks – Imagerepresentations– 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 , Zero-crossings of the second derivative,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 (OYLO)-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, FaceNet for Face Recognition, Implementation using FaceNet,Gesture Recognition.

UNIT – V

Video Analytics: Video processing, use cases of video analytics, Vanishing Gradient and exploding gradient problem, Restnet architecture – RestNet and skip connections, Inception Network, GoogleNet architecture, Improvement in Inception v2,Video analytics, RestNet and Inception v3.

Text Books:

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/

22ADE26

SOFTWARE DEFINED NETWORKING

(Professional Elective-III)

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

Course Objective: This course aims to:

1. Understand the Evolution and Necessity of SDN.
2. Develop Network Programmability Skills.
3. Explore SDN Applications and Security.

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

1. Use Mininet to demonstrate basic SDN functionalities and set up an environment to implement SDN aspects.
2. Compare various SDN controllers including VMware, Nicira, and Cisco One PK, and assess their applications in network management.
3. Develop network applications using the NetApp platform and deploy network solutions using ONOS and OPNFV frameworks.
4. Demonstrate proficiency in using The Open Network Operating System (ONOS) for managing network operations effectively.
5. Evaluate the application of SDN technologies in legacy networks and propose strategies for integrating SDN to improve security and efficiency.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	1	2	1	1	1	2	1	2	2	2
CO2	2	3	2	1	2	2	1	2	2	2	3	1	2	1	2
CO3	2	2	3	1	3	2	2	2	2	2	2	1	3	2	3
CO4	3	2	1	3	2	1	2	3	2	3	1	2	2	2	3
CO5	3	2	1	2	3	2	3	2	3	2	1	3	2	2	3

UNIT-I

Introduction: Evolution of SDN, Need for SDN, Centralized and Distributed Control and Data Planes, The Genesis of SDN Introducing Mininet, Setting up the Environment and Implementation of SDN Aspects in Mininet.

UNIT-II

Working principle of SDN: OpenFlow Protocol **SDN Controllers:** Introduction, General Concepts, VMware, Nicira, OpenFlow Related Mininet, NOX/POX, Trema, Ryu , Floodlight, Layer 3 Centric, Plexxi, Cisco One PK , Implementation of Custom Topologies in POX, ODL, Floodlight 3 Click, ONOS. **Interfacing:** Northbound – Southbound and Eastbound -Westbound.

UNIT-III

Network Programmability: Network Function Virtualization, NetApp Development, Network Slicing, ONOS deployment ONOS, OPNFV.

UNIT-IV

SDN in the Data Center: SDN in Other Environments, SDN Applications, SDN Use Cases, The Open Network Operating System 3.

UNIT-V

SDN Open Source: SDN Future, SDN security, Switching and Load Balancers, Firewall and Access Control, Use cases in Legacy Networks security.

Text Book:

1. Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2016 Reprint

Suggested Readings:

1. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013 3.
2. Software Defined Networking with OpenFlow By SiamakAzodolmolky, Packt Publishing, 2013
3. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98

Web Resources:

1. https://www.coursera.org/learn/sdn
2. https://www.udemy.com/topic/software-defined-networking/
3. https://www.classcentral.com/subject/sdn

22ITE13

UNMANNED AERIAL VEHICLES

(Professional Elective-III)

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

Course Objectives:

This course aim to:

1. Explain the locomotion principle, describe different types of mobile robots, and the basics of Unmanned Arial Vehicles (Drones) and its 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 completing this course, students will be able to:

1. Illustrate the types, characteristics, Applications of UAVs.
2. Analyze the concepts of Aerodynamics, Propulsion & Structures of Model aircraft.
3. Identify/Know the payload and its corresponding propeller's RPM to fly the drone successfully.
4. Infer with the Launch and recovery mechanism of a UAVs.
5. Know the Navigation and Guidance System of UAVs.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	1	-	1	1	1	1	2	2	1
CO2	2	2	1	2	-	2	1	-	-	1	1	1	2	2	1
CO3	2	2	1	1	-	2	1	-	1	1	1	1	1	1	-
CO4	2	2	1	1	1	2	2	-	1	1	1	1	1	1	-
CO5	2	2	1	1	1	2	1	-	-	1	1	1	3	3	3

UNIT-I

Introduction to Autonomous systems: Definition, Characteristics, differences between non autonomous Vs autonomous, Types of vehicles, Introduction to navigation and communication.

UNIT-II

Basics of navigation (Aerial and Ground): Different types of flight vehicles; Components and functions of an airplane; Forces acting on Airplane; Physical properties and structure of the atmosphere; Aerodynamics – aerofoil nomenclature, aerofoil 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, Robot

Arm Kinematics and Dynamics, Manipulator Trajectory planning and Motion Control, Robot Sensing, Robotic Operating System, Robotic Programming Languages.

UNIT-IV

Navigation and guidance: Data Link; 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); cameras; ultra-sonic detectors; Introduction to navigation systems and types of guidance; Mission Planning and Control, Case studies: Autonomous Obstacle avoidance - Vision, Sonar and LiDAR.

UNIT-V

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.

Suggested Books and Resources:

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
4. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, Robotics : Control, Sensing, Vision and Intelligence
5. Aaron Martinez, Enrique Fernandez, Learning ROS for Robotics Programming: A practical, instructive, and comprehensive guide to introduce yourself to ROS, the top-notch, leading robotics framework, PACKT publishing, Open Source.
6. John J. Craig, Introduction to Robotics: Mechanics and Control, Addison Wesley publication, Third Edition.

22BTO03

BIOTERRORISM AND NATIONAL SECURITY

(Open Elective-I)

Instruction	3L 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 an in-depth characterization of different forms of bioterrorism, agro errorism, 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 the 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	PO12
CO1	1	0	0	1	1	2	2	1	0	0	0	0
CO2	1	0	0	0	1	3	1	0	0	0	0	0
CO3	1	0	0	1	1	2	1	2	0	0	0	0
CO4	2	1	0	1	1	2	2	0	0	0	0	0
CO5	1	0	0	0	0	3	2	1	0	0	0	2

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

Text Books:

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.

Suggested 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, Biotechnology research in an age of terrorism

22MTO01

FUNDAMENTALS OF QUANTUM COMPUTING

(Open Elective-I)

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 fundamental 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	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	-			
CO 2	2	2	-	-	-	-	-	-	-	-	-	-			
CO 3	2	2	1	-	-	-	-	-	-	-	-	-			
CO 4	2	2	2	2	-	-	-	-	-	2	2	-			
CO 5	2	2	2	2	-	-	-	-	-	2	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.

Text Books:
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-I)

Instruction	3L 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-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	2	1	1	-	1	1	2	3	3	2	3	2	1	2
CO 2	-	1	-	1	-	-	-	1	2	2	1	2	1	1	1
CO 3	-	2	-	2	-	1	1	1	2	3	2	2	2	2	2
CO 4	2	2	1	3	-	2	2	1	3	3	2	2	2	2	2
CO 5	1	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-I)

Instruction	3L Hours per week
Duration of SEE	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 technique.

Course Outcomes: On Successful completion of this course, 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	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	-	-	-	-	-	-	2			
CO 2	3	3	2	1	-	-	-	-	-	-	-	2			
CO 3	3	3	2	1	-	-	-	-	-	-	-	2			
CO 4	3	3	2	1	-	-	-	-	-	-	-	2			
CO 5	3	3	2	1	-	-	-	-	-	-	-	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).

Text Books:

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.

Web Resources:

1. https://nptel.ac.in/courses/111105039
2. https://nptel.ac.in/courses/105108127

22MBO03

ORGANIZATIONAL BEHAVIOUR

(Open Elective-I)

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 behaviour 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 behaviour.
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 Behaviour 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:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	1	-	2	2	1	-	-	-	-	-	-
CO 2	-	1	-	1	1	2	-	-	-	-	-	-
CO 3	1	2	1	2	1	1	-	-	-	-	-	-
CO 4	1	1	1	1	2	1	-	-	-	-	-	-
CO 5	1	1	1	2	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.

Text Books:

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.

22ADC13

BIG DATA ANALYTICS LAB

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

Course Objectives:

1. To provide the knowledge to set up a Hadoop Cluster and implement applications using MapReduce.
2. To introduce Pig, PigLatin 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 SparkSQL.
5. To build end-to-end stream processing pipelines using Kafka and related technologies.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand 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 SparkSQL.
5. Apply practical skills in integrating Kafka with Spark Streaming and implementing real-time analytics use cases such as Fraud Detection, Clickstream Analysis, and Real-time Monitoring.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	2	1	-	2	-	3	2	2	1
CO2	2	3	2	3	1	3	-	-	-	2	-	3	2	2	1
CO3	2	3	2	3	3	3	3	3	-	2	3	3	2	2	1
CO4	2	3	2	3	3	3	3	3	3	2	3	3	2	2	1
CO5	2	3	2	3	3	3	3	3	3	2	3	3	3	3	3

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 structured streaming using spark with retail store dataset
7. Implement streaming using Kafka

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018
3. Tanmay Deshpande, “Hadoop Real-World Solutions Cookbook”, 2nd Edition, Packt Publishing, 2016.
4. Anand Rajaraman and Jeffrey David Ullman, ―Mining of Massive Datasets, Cambridge University Press, 2012.
5. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017
6. Viktor Gamov, "Kafka Streams in Action", 1st Edition, Manning Publications, 2018.

Suggested Reading:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "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
4. http://bigdatauniversity.com

22CAC05

DEEP LEARNING LAB

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

COURSE OBJECTIVES:

The course aim is:

1. Understand basic concepts of Deep learning and their applications.
2. Evaluating Deep learning methods, models and algorithms.
3. Analyzing CNN, RNN, Transformers and GAN along with their applications.

COURSE OUTCOMES:

1. Evaluate the performance various optimization techniques used in deep learning.
2. Analyze various Auto encoders and Regularization Techniques.
3. Design and Develop various Convolution Neural Networks architectures.
4. Analyze various RNNs and Encoder Decoder Models.
5. Understand the importance of Transformers and GANs to develop real-time applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	1	1	1	1	1	2	2	3	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2	2	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	2	2	3	2
CO4	3	3	3	3	3	1	1	1	2	2	2	3	3	3	2
CO5	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3

LIST OF EXPERIMENTS:

1. Understanding of Deep learning Packages Basics: Tensorflow, Keras, Theano and PyTorch.
2. Implementation of Classification with Multilayer Perceptron using Scikit-learn with MNIST Dataset.
3. Compare the Performance of various Optimization techniques of Momentum Based GD,Stochastic GD, Adam.
4. Compare the Performance of the Classification model using various Regularization Techniques.
5. Train a Deep learning model to classify a given image using pre trained model of AlexNet, VGGNet and compare their performance.
6. Implementation of De noising auto encoders.
7. Implementation of RNN for text generation.
8. Implementation of Encoder Decoder Models.
9. Understand the Fine tuning of BERT Models.
10. Implementation of GANs for generating synthetic datasets.

TEXT BOOKS:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Learning Generative Adversarial Networks: Next-generation deep learning simplified by Kuntal Ganguly, Packt, 2017
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
4. Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow by Benjamin Planche, Eliot Andres, Packt Publishers, 2019
5. Huang, Shih-Chia, and Trung-Hieu Le. Principles and labs for deep learning. Academic Press, 2021.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85

22CIC08

INDUSTRIAL INTERNET OF THINGS SYSTEMS LAB

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

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:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	-	-	1	-	-	-	1	1	1	-
CO2	1	1	1	1	1	-	-	-	-	-	-	1	1	1	-
CO3	1	1	1	1	-	-	-	-	-	-	-	1	-	1	-
CO4	1	1	1	1	1	-	-	-	1	-	-	1	1	1	-
CO5	1	1	1	1	1	1	1	-	1	-	1	1	2	2	1

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 motor when the temperature is high.
5. Write a program to interface LCD with Raspberry Pi and print temperature and humidity readings on it.
6. Write a program to interface flame/smoke sensor with Arduino /Raspberry Pi and give an alert message when flame/smoke is detected.
7. 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.

Text Book:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested 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, 201.

Web Reference:

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:
3. IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.
4. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”, Internet Engineering Task
5. Force (IETF), Standards Track, 2014.
6. L.Fenzel, “What‟s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”, Electronic Design (Online), Mar. 2013.
7. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
8. F. Luo et al., "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging
9. Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.

22EGC03

EMPLOYABILITY SKILLS

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	01

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 to 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-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	1	-	-	-	1	-	2	3	3	1	3	1	-	1
CO 2	-	-	-	-	-	-	-	1	-	2	-	1	-	-	2
CO 3	-	-	-	-	-	1	-	1	2	1	1	3	1	1	1
CO 4	-	1	1	-	-	1	-	2	3	3	1	3	1	1	1
CO 5	-	-	-	-	-	-	-	1	2	2	1	3	-	-	2

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

Behavioural 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.

Text Books:

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.

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 (A)

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

B.E (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.	22ADC14	Generative AI	3	-	3	40	60	3
2.		Open Elective – 2	3	-	3	40	60	3
3.		Professional Elective – 4	3	-	3	40	60	3
4.	22EEM01	Universal Human Values II: Understanding Harmony	1	-	-	50	-	1
PRACTICAL								
5.	22ADC15	Generative AI Lab	-	2	3	50	50	1
6.		Professional Elective – 4 Lab	-	2	3	50	50	1
7.	22ADC16	Project Part – 1	-	4	-	50	-	2
8.	22ADI02	Industrial / Rural Internship	4-6 Weeks 135 Hours		-	50	-	2
			10	**8**	**15**	**370**	**280**	**16**
Clock Hours Per Week: 18								

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

Professional Elective #4	Cyber Physical Systems (22ADE27)	Computer Vision (22ADE29)	Devops Tools (22ITE11)	Natural Language Processing (22CAE19)	Reinforcement Learning (22CAE08)
Professional Elective #4 Lab	Cyber Physical Systems Lab (22ADE28)	Computer Vision Lab (22ADE30)	Devops Tools Lab (22ITE12)	Natural Language Processing Lab (22CAE20)	Reinforcement Learning Lab (22CAE09)

Open Elective #2	Infrastructure for Smart Cities (22CEO01)	Intelligent Transportation System (22CEO05)	Fundamentals of Electrical Vehicles (22EEO07)	Cognitive Neuroscience (22BTO05)	Neural Networks & Fuzzy Logic (22ECO07)

22ADC14

GENERATIVE AI

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

Course Objectives:

1. To learn the fundamental concepts of Generative AI
2. To acquire the knowledge of encoders, decoders and autoregressive models
3. To acquire the knowledge of various generative models for image generation, style transfer and text generation
4. To learn to apply transforms, prompt engineering and APIs for real world problems
5. To learn to implement develop application using chat GPTs and open API

Course Outcomes:

1. Understand the fundamental concepts and techniques of generative AI, including GANs and VAEs.
2. Develop and implement generative models using various architectures and algorithms.
3. Evaluate the performance of generative models using suitable metrics and datasets.
4. Apply generative AI techniques to solve real-world problems in different domains.
5. Use state-of-the-art tools and frameworks for developing and testing generative AI models.

CO-PO Articulation Matrix:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	2	-	-	-	1	1	1	1	3	3	3
CO 2	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO 3	3	3	3	2	2	-	-	-	1	1	1	1	3	3	3
CO 4	3	3	3	2	2	-	-	-	1	1	1	1	3	3	3
CO 5	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3

UNIT-I

Introduction: An Introduction to Generative AI, Applications of AI, The rules of Probability, Why use generative models, Unique challenges of generative models.

UNIT-II

Auto Encoders and Autoregressive Models: Auto encoders, Regularized autoencoders, Stochastic Encoders and Decoders, Autoregressive Models, Fully Visible sigmoid Belief Network (FVSBN), Neural Autoregressive Density Estimation (NADE), Masked Autoencoder for Distribution Estimation (MADE)

UNIT III

Generative Adversarial Network: Generative Adversarial Networks, Vanilla GAN, Progressive GAN, Style transfer and Image transformation, Image Generation with GANs, Style Transfer with GANs

UNIT-IV

Transformers and Prompt Engineering: Transformers, Large Language Models, MLM/NSP, Generative Pretrained Transformers (GPT), Task – Specific GPT Fine Tuning, Prompt Engineering, Hugging face pretrained Transformers, Hugging face APIs

UNIT-V

Chat GPTs and OpenAI GPT 3, 3.5, 4, OpenAI APIS, working with the OpenAI Playground, Application and Use Cases: Content Filtering, Generating and Transforming Text, Classifying and Categorizing Text, building a GPT-3, Powered Question, Answering APP

Text 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

Suggested Reading:

1. Sabit Ekin, Prompt Engineerign for Chat GPT: Aquick Guide to Techniques, Tips, and Best Practices, DOI: 10.36227/techrxiv.22683919.v2, 2023
2. Fregly Chris, Antje Barth, and Shelbee Eigenbrode. Generative AI on AWS: building context-aware multimodal reasoning applicaions, Orielly, 2023.
3. Auffarth, B. "Generative AI with Langchain: Build large language model (LLM) apps with python, chatgpt, and other llms." Packt Publishing, 2023.

Web Resources:

1. https://huggingface.co/
2. https://www.udemy.com/course/generative-ai-for-beginners-b/
3. https://www.coursera.org/learn/generative-ai-with-llms?
4. https://ai.google/discover/generativeai/

22CEO01

INFRASTRUCTURE FOR SMART CITIES

(Open Elective-II)

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

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. Summarise 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	PO12
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	2	-	-	-	-	1	-	-	-	-	-	-
CO3	2	-	-	-	3	1	-	-	-	-	-	-
CO4	2	3	-	-	3	1	-	-	-	-	-	-
CO5	2	-	-	-	-	1	-	-	-	-	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.

Text Books:

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

Suggested Reading:

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.

Web 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-II)

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	PO12	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 Centres (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.

Text Books:

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.

Suggested Reading:

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.

Web 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-II)

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:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	1	1	1	-	-	2	3	-	2	1	2	1
CO2	1	1	1	-	-	2	3	-	2	1	2	1
CO3	1	1	1	-	-	2	3	-	2	1	2	1
CO4	1	1	1	-	-	2	3	-	2	1	2	1
CO5	1	1	1	-	-	2	3	-	2	1	2	1

1 - Slightly; 2 - Moderately; 3 - Substantially

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 wheels , Suspension system, Driveshaft, Mechanical transmission , Electric Motor. The energy source subsystem -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”, Newnes, 2000.

22BTO 05

COGNITIVE NEUROSCIENCE

(Open Elective-II)

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: The main objectives of this course are to:
1. Understanding the brain effects that give rise to our abilities to perceive, act and think
2. Gain skills on the way that cognition is associated with neural activity
3. Compare and contrast the organization and function of numerous systems within the brain

Course Outcomes: At the end of the course, students will be able to:
1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand brain's neuro-transimitter system.
3. Understanding the brain's methods gives rise to behaviour whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.
5. Understand the feedback system and brain disorders.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	0	2	0	0	0	2	0	3
CO2	1	1	1	1	0	2	0	0	0	2	0	3
CO3	1	1	1	1	0	2	0	0	0	2	0	3
CO4	1	2	2	3	3	3	0	3	1	3	0	3
CO5	1	1	2	3	3	3	0	3	1	3	0	3

UNIT-I

Introduction to neuroscience: Outline of neuroanatomical; Neurogenesis, migration Axon path-finding; cell death; Role of neural activity in development; Membranes and membrane potentials.

UNIT-II

Action potential: Conductance mechanisms; Chemical and electrical transmission; Postsynaptic potentials; neural integration; Energy consumption in the brain; Attention; Methods jigsaw; Executive Control; Evolution/development; Sheep's brain dissection.

UNIT-III

Neurotransmitter systems: Visual information processing; Visual cortex; Visual plasticity; critical periods; Somatosensory system; Pain; Chemoreception; Auditory system; Spinal mechanisms; Brain mechanisms.

UNIT-IV

Human and Animal Memory: Pattern completion and separation; LTP and synapses; Spatial cognition; Social cognition; Cellular mechanisms of neural plasticity.

UNIT-V

Feedback System and Brain Disorders: Endocrine systems; feeding behaviour, Stress, Addiction, Depression, Schizophrenia, Alzheimer's, Huntington's disease, Parkinson's disease.

Text Books:

1. Principles of Neural Science, 6th Edition (2021) Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell, McGraw Hill.
2. Principles of Cognitive Neuroscience, 2nd Edition (2013) Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff. Sinauer Associates, Inc.
3. Mark Bear, Brian Connors, and Michael Paradiso (2007) Neuroscience: Exploring the Brain. 3rd ed. Baltimore: Lippincott, Williams & Wilkins.

22ECO07

NEURAL NETWORKS AND FUZZY LOGIC

(Open Elective II)

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.

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	-	-	-	-	-	-	-	3	3	1
CO 2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	1
CO 3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	1
CO 4	3	3	3	2	3	-	2	-	-	-	-	2	3	3	1
CO 5	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 Rajasekharan and Pai – PHI Publications.
3. Fundamental of Artificial Neural Network and Fuzzy Logic-by Rajesh Kumar, Lakshmi publications

Suggested 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.

22ADE27

CYBER PHYSICAL SYSTEMS

(Professional Elective –IV)

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

Course Objectives:

The objectives of this course are to:

1. Introduce modeling of CPS
2. Introduce ability to analyze and simulate CPS systems
3. To learn about design of cyber-physical systems
4. Acquire knowledge and skills on various hardware and software design aspects of Cyber Physical Systems (CPS) - modeling, analysis, and design.
5. Develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective, but based equally on the principles of automated control.

Course Outcomes:

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

1. Describe the concepts and explain Microcontroller and Embedded Systems
2. Apply essential tools for Embedded systems.
3. Analyze and construct Embedded system concepts to solve real word problems
4. Examine and expand solution to automated systems to make life easier
5. Demonstrate embedded systems concepts with existing systems
6. Ability to develop concepts, logics towards solving an unknown problem in research and industry.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	3	2	2	3	1
CO2	3	2	3	-	-	-	-	-	-	-	3	2	2	3	1
CO3	3	2	3	-	-	-	-	-	-	-	3	2	3	3	2
CO4	3	2	3	-	-	-	-	-	-	-	3	2	3	3	2
CO5	3	2	3	-	-	-	-	-	-	-	3	2	2	3	1
CO6	3	2	3	-	-	-	-	-	-	-	3	2	3	3	3

UNIT 1:

Introduction: Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT II:

CPS Platform components: CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model

UNIT III:

Synchronous and Asynchronous Model: Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election.

UNIT IV:
Security of Cyber-Physical Systems: Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities

UNIT V:
CPS Application: Health care and Medical Cyber-Physical Systems, Smart grid and Energy CyberPhysical Systems, WSN based Cyber-Physical Systems, Smart Cities**.**

Text Books:
1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015
3. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley,2017

Suggested Reading:
1. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015
2. Fei Hu, "Cyber-Physical Systems", CRC Press 2013.

Web Resources:
1. https://onlinecourses.nptel.ac.in/noc23_cs62/preview
2. http://acl.digimat.in/nptel/courses/video/106105241/L56.html

22ADE29

COMPUTER VISION

(Professional Elective –IV)

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

Prerequisite: Knowledge on Matrices, Linear Algebra and Calculas

Course Objectives:
This course aims to:
1. To introduce the fundamentals of image formation
2. To provide understanding of segmentation and Augmentation techniques in Computer Vision
3. To Identify and interpret appropriate sources of information relating to computer vision.
4. To analyse, evaluate and examine existing practical computer vision
5. To Design and develop practical and innovative image processing and computer vision applications.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the fundamental concepts and techniques in computer vision.
2. Implement image processing and computer vision algorithms for various applications.
3. Analyze and interpret visual data using advanced computer vision techniques.
4. Develop computer vision applications to solve real-world problems.
5. Evaluate the performance of computer vision systems using appropriate metrics.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO2	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO3	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO4	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO5	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3

UNIT – I

Introduction to Computer Vision and Basic Concepts of Image Formation: Introduction and Goals of Computer Vision and Image Processing, Image Formation Concepts, **Fundamental Concepts of Image Formation**: Radiometry, Geometric Transformations, Geometric Camera Models.

UNIT – II

Fundamental Concepts of Image Formation: Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections. **Image Processing Concepts**: Image Transforms, Image Transforms, Image Enhancement, Image Filtering, Color Image Processing, Image Segmentation.

UNIT - III

Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries, Object Boundary and Shape Representations, Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency.

UNIT - IV

Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.

UNIT – V

Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoders, Gesture Recognition, Motion Estimation and Object Tracking, Programming Assignments.

Text Books:

1. Manas Kamal Bhuyan, "COMPUTER VISION AND IMAGE PROCESSING FUNDAMENTALS AND APPLICATIONS", Taylor & Francis, 2020

Suggested Reading:

1. David A. Forsyth , "COMPUTER VISION A MODERN APPROACH, Pearson, 2012
2. Richard Szeliski, "Computer Vision Algorithms and Applications", Second edition, Springer, 2022.
3. E.R.Devis, "Computer and Machine Vision: Theory, Algorithms, Practicalities, Fourth edition, Appress, 2012

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs124/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs89/preview
3. https://onlinecourses.nptel.ac.in/noc24_ee133/preview
4. https://onlinecourses.swayam2.ac.in/nou24_cs08/preview

22ITE11

DEVOPS TOOLS

(Professional Elective –IV)

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

Course Objectives:

The aim of this course is:

1. To study the fundamentals of DevOps.
2. To describe version control tools in DevOps
3. To study the integration process in DevOps.
4. To understand the containerization in DevOps.
5. To describe the deployment process in DevOps.

Course Outcomes:

Upon completing this course, students will be able:

1. To identify the components of DevOps.
2. To interpret the Git for source code management.
3. To investigate the integration process in DevOps.
4. To express proficiency in containerization using Docker.
5. To articulate the deployment process in DevOps.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	2	1	-	1	2	1	2	1	1	1	2
CO2	1	2	1	1	2	1	-	1	2	1	2	1	1	3	2
CO3	1	1	1	1	2	1	-	1	2	1	3	1	1	2	2
CO4	1	2	1	1	2	1	-	1	2	1	3	1	1	2	2
CO5	1	2	1	2	3	1	-	1	2	1	3	1	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 Gitflow pattern: Starting with the Git Process, Isolating your code with branches, Branching Strategy with Gitflow.

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 Swarm**

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 SaltStack, DevOps Best Practices, **Tools: Ansible, Saltstack**

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.

Suggested Reading:

1. Ryan Russell and Jason Southgate, "Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet", Packt Publishing ,2018.
2. Joakim Verona, "Practical DevOps", 2nd edition ,Packt Publishing , 2018.

22CAE19

NATURAL LANGUAGE PROCESSING

(Professional Elective-IV)

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

Course Objectives:

The objectives of this course are:

1. Understand various Natural Language Processing Fundamentals.
2. Understand probabilistic NLP and classification of text using Python's NLTK Library
3. Understand various text representations and labelling techniques.
4. Understand various NLP models and named entities.
5. Learn RNN for NLP.
6. Understand usage of GRU and LSTM models for translation.
7. Understand various applications of NLP.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the fundamentals of Natural Language Processing, manipulate and analyse language data.
2. Demonstrate key concepts from NLP, text representation and linguistics to describe and analyse language.
3. Demonstrate the word embedded techniques and classification of the text.
4. Make use of the Deep learning and Transformers for NLP.
5. Develop NLP applications using appropriate NLP tools and techniques.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	2	2	2	2	2	2	2	2	3	2	3	0
CO 2	2	2	3	2	2	2	2	2	2	3	2	3	3	2	0
CO 3	2	2	3	2	2	2	2	2	2	3	2	3	3	2	0
CO 4	2	3	2	2	2	2	2	2	2	2	2	3	3	3	2
CO 5	2	2	3	2	2	2	2	2	2	3	2	3	3	2	0

UNIT- I:

Introduction to NLP: Definition, History, NLP in the real world, Approaches to NLP, NLP Pipeline. Language Processing and Python: Computing with Language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics. Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency.

UNIT- II:

Basic Vectorization approaches of Text Representation: One-Hot Encoding, Bag of Words, Bag of N-Gram, TF-IDF; Distributed universal text and handcrafted feature Representations, Neural language models, N-gram language model. Processing Raw Text: Accessing Text from the Web and from Disk, Text Processing with Unicode. Categorizing and Tagging Words: Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging.

UNIT-III:

Word Embeddings: Count Vector, Frequency based Embedding, Prediction based Embedding, Word2Vec and Glove. Learning to Classify Text: Supervised Classification and Text classification with Machine learning algorithms.

UNIT-IV:

Deep learning for NLP: RNN for language model, Sequence Labelling and Sequence Classification, Encoder-Decoder with RNNs, GRUs and LSTMs for machine translation, Convolutional neural networks for sentence classification and Evolution metrics for NLP. Transformers for NLP: Attention, Transformers and BERT.

UNIT-V:

Case Study on NLP: Sentiment analysis, Machine translation, Automated speech recognition systems, Question-answering based systems, Topic modelling, Text Generation and Summarization.

Text Books / Suggested Reading:

1. Steven Bird, Ewan Klein, and Edward Lope, Natural Language Processing with Python. O‟Reily,2009.
2. Deep Learning for Natural Language Processing Develop Deep Learning Models for Natural Language in Python (Jason Brownlee), Machine Learning Mastery,2017.
3. Lewis Tunstall, Leandro von Werra, Thomas Wolf - Natural Language Processing with Transformers_ Building Language Applications with Hugging Face-O'Reilly Media (2022).
4. Akshay Kulkarni, Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Apress, 2019.
5. Sudharsan Ravichandiran ,Getting Started with Google BERT Build and train state-of-the-art natural language processing models using BERT.

Web Resources:

1. https://models.quantumstat.com/
2. https://www.coursera.org/learn/attention-models-in-nlp
3. https://github.com/keon/awesome-nlp

22CAE08

REINFORCEMENT LEARNING

(Professional Elective-IV)

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.
2. To apply the concepts of Finite Markov Decision Processes and Value Functions.
3. To Analyze Monte Carlo Methods and Temporal-Difference learning techniques.
4. Evaluate the use of Eligibility Traces in reinforcement learning through case studies
5. To create and build solutions to solve complex problems

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

1. Acquire the key concepts and terminology in Reinforcement Learning, such as Markov Decision Processes and Action-Value Methods.
2. Apply the reinforcement learning to solve real world problems, including optimizing n-armed bandit problems and job-shop scheduling.
3. Analyze and evaluate the effectiveness of Monte Carlo methods, Temporal-Difference learning, and Eligibility Traces in various real-world applications.
4. Evaluate the performance of different reinforcement learning approaches and assess their suitability for specific tasks and domains.
5. Design and implement novel reinforcement learning solutions to address real-world challenges and improve decision-making processes.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	1	-	2	-	-	2	2	1
CO2	1	3	2	-	-	-	-	2	-	2	-	2	2	3	1
CO3	1	3	2	1	-	-	-	2	-	-	-	2	2	3	1
CO4	1	-	1	1	-	-	-	1	-	-	-	2	1	2	1
CO5	1	-	1	1	-	-	-	1	-	-	-	3	1	2	2

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.

Text Books:

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.

Suggested Reading:

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.

Web Resources:

1. https://www.coursera.org/specializations/reinforcement-learning
2. https://nptel.ac.in/courses/106106143

22EEM01

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

Instruction	1 T Hour per Week
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:
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:
By the end of the course, 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 behavior by adhering to principles of integrity, honesty, compassion, and justice.
4. Recognize their role as global citizens.
5. Exhibit a sense of social responsibility.

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 to identify the scope and characteristics of people friendly and eco-friendly production systems,
c. Ability to 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 40%. 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.

Suggested Reading:

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

CO-PO-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	-
CO 2	-	-	1	-	-	1	1	-	1	-	1	1	-	-	-
CO 3	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
CO 4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-

22ADC15

GENERATIVE AI LAB

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

Course Objectives:

1. Understand fundamental concepts of generative AI models including autoencoders, 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:

1. Gain practical experience in implementing generative AI models using popular frameworks and libraries.
2. Experiment with different types of generative models, including GANs and VAEs.
3. Analyze and interpret the results of generative model experiments.
4. Develop and document generative AI projects that address real-world problems.
5. Present findings and collaborate effectively within a team setting.

CO-PO-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO2	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO3	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO4	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO5	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3

List of Programs:

1. Implement a basic autoencoder using TensorFlow or PyTorch and train it on a dataset like MNIST for image reconstruction.
2. Explore different regularization techniques such as L1/L2 regularization or dropout and compare their effects on the autoencoder's performance.
3. Implement a variational autoencoder (VAE) and train it on a dataset like FashionMNIST to generate new images.
4. Implement a basic autoregressive model like the Fully Visible Sigmoid Belief Network (FVSBN) using PyTorch or TensorFlow and train it on a sequential dataset like time series data.
5. Implement NADE and train it on a dataset like CIFAR-10 for image generation.
6. Implement MADE and train it on a dataset like CelebA for image generation.
7. Implement a Vanilla GAN using TensorFlow or PyTorch and train it on a dataset like CIFAR-10 for image generation.
8. Implement Progressive GAN and train it on a large dataset like LSUN for high-resolution image generation.
9. Implement a style transfer algorithm using GANs and apply it to images from the CIFAR-10

dataset.

10. Implement a basic transformer model using PyTorch or TensorFlow and train it on a text dataset like WikiText-2 for language modeling.
11. Fine-tune a pre-trained GPT model on a specific task such as sentiment analysis using a dataset like IMDB reviews.
12. Utilize the OpenAI API to build a question-answering application powered by GPT-3, allowing users to input questions and receive relevant answers.

Suggested Reading:

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 Engineerign for Chat GPT: Aquick Guide To Techniques, Tips, and Best Practices, DOI: 10.36227/techrxiv.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 1. x: Implement next-generation neural networks to build powerful GAN models using Python. Packt Publishing Ltd, 2019.

22ADE28

CYBER PHYSICAL SYSTEMS LAB

(Professional Elective-IV LAB)

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

Course Objectives:

The objectives of this course are to:

1. To learn about design of cyber-physical systems
2. Categorize the essential modeling formalisms of Cyber-Physical Systems (CPS).
3. Analyze the functional behavior of CPS based on standard modeling formalisms.
4. Implement specific software CPS using existing synthesis tools.
5. Design CPS requirements based on operating system and hardware architecture constraints.

Course Outcomes:

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

1. Analyze the practical aspects of cyber-physical systems.
2. Evaluate the essential tools to implement CPS for different application Domain
3. Identify Security mechanisms of Cyber-physical systems
4. Create real-world applications related to cyber-physical systems.
5. Apply CPS to implement different CPS application models

CO-PO-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	2	2	3	3	2
CO2	3	3	-	-	3	-	-	-	-	-	2	2	2	3	2
CO3	3	3	-	-	3	-	-	-	-	-	2	2	3	2	2
CO4	3	3	-	-	-	-	-	-	-	-	2	2	3	3	2
CO5	3	3	-	-	3	-	-	-	-	-	2	2	3	3	2

List of Programs:

1. Familiarity to Embedded and robot platform.
2. Familiarity to Embedded C and hardware interfacing.
3. Implementation of Moore Machine using Traffic Light Controller.
4. Implementation of Mealy Machine using rocket controller.
5. Implementation of line robot.
6. Write a program in MATLAB to implement open loop system stability.
7. Write a program in MATLAB to implement timed automation.
8. Write a program in MATLAB to implement conveyor belt automation
9. Write a program in MATLAB to implement PID controllers for drones
10. Implement a machine learning algorithm for an autonomous robotics (CPS).
11. Study the machine learning in smart grids and monitoring.

Text Books:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015

Suggested Reading:

1. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, http://LeeSeshia.org, ISBN 978-1-312-42740-2, 2015.
2. Rajeev Alur. Principles of Cyber-Physical Systems. MIT Press. 2015

Web Resources:

1. http://cse.iitkgp.ac.in/~soumya/cps/cps.html
2. https://lab.vanderbilt.edu/taha/teaching/ee-5243-optimization-and-control-of-cyber-physical-systems/

22ADE30

COMPUTER VISION LAB

(Professional Elective-IV LAB)

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

Prerequisite: Python Programming

Course Objectives:
This course aims to:
1. To Preprocess Image data
2. To find Objects from Images and videos
3. To get knowledge about Segmentation and generation of new images
4. To Apply Deep Learning Networks for Image Classification
5. To reuse Pre trained models using Transfer Learning

Course Outcomes:
Upon completion of this course, students will be able to:
1. Gain hands-on experience with computer vision tools and libraries.
2. Implement and test computer vision algorithms in a lab environment.
3. Analyze the results of computer vision experiments.
4. Develop and document computer vision projects addressing real-world problems.
5. Collaborate effectively in a team to solve computer vision challenges.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO 2	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO 3	3	3	3	2	3	-	-	-	1	1	1	1	3	3	3
CO 4	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3
CO 5	3	3	3	3	3	-	-	-	1	1	1	1	3	3	3

List of Programs:
1. Demonstrate Loading, Exploring, and Showing an Image, Manipulate Image Pixels and Transforming Image
2. Implement AlexNet from Scratch
3. Implement R-CNN and Faster R-CNN for Object Detection
4. Use YOLO series Networks for multi Object detection
5. Use Data Augmentation to Improve Network Accuracy
6. Use Pertained GoogLeNet for Image Classification
7. Implement VGG16 from Scratch for image classification
8. Implement GAN series to generate Images
9. Implement encoder and decoder technique for semantic Segmentation
10. Demonstrate how to use Transfer Learning for Image Classification

Text Books:
1. Krishnendu Kar , “Mastering Computer Vision with TensorFlow 2.x “ PACKT Publications

Suggested Reading:

1. David A. Forsyth , "COMPUTER VISION A MODERN APPROACH, Pearson, 2012
2. Richard Szeliski, "Computer Vision Algorithms and Applications", Second edition, Springer, 2022.
3. E.R.Devis, "Computer and Machine Vision: Theory, Algorithms, Practicalities, Fourth edition, Appress, 2012

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc24_cs124/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs89/preview
3. https://onlinecourses.nptel.ac.in/noc24_ee133/preview
4. https://onlinecourses.swayam2.ac.in/nou24_cs08/preview

22ITE12

DEVOPS TOOLS LAB

(Professional Elective-IV LAB)

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

Course Objectives:

The aim of this lab is:

1. To study the DevOps fundamentals for software development.
2. To know the Version Control using GIT to handle the coding.
3. To build, test and deploy applications using Jenkins and Maven.
4. To use the docker for containerization.
5. To build the deployment process of software.

Course Outcomes:

Upon completing this course, students will be able:

1. To apply the DevOps basics for product development.
2. To demonstrate the version control tools.
3. To examine the Jenkin and Maven tools.
4. To demonstrate the Docker for containerization.
5. To describe the deployment process using puppet.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	3	3	1	-	1	2	1	2	2	1	2	2
CO2	1	1	3	3	3	1	-	1	2	1	2	2	1	2	2
CO3	1	1	3	3	3	1	-	1	2	1	3	2	1	2	2
CO4	1	1	3	3	3	1	-	1	2	1	3	2	1	2	2
CO5	1	1	3	3	3	1	-	1	2	1	3	2	1	2	2

List of Experiments:

S. No	Experiment Title
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 To 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 commands to manage images and interact with containers.

7.	To learn Docker file instructions, build an image for a sample web application using Docker file.
8.	Deploy a containerized application on Kubernetes cluster.
9.	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
10.	To learn Software Configuration Management and provisioning using Puppet Blocks(Manifest, Modules, Classes, Function)

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.

Suggested Reading:

1. Ryan Russell and Jason Southgate, "Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet", Packt Publishing, 2018.
2. Joakim Verona, "Practical DevOps", 2nd edition, Packt Publishing, 2018.

22CAE20

NATURAL LANGUAGE PROCESSING LAB

(Professional Elective-IV LAB)

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

Course Objectives:

The objectives of this course are:

1. To learn the fundamentals of natural language processing.
2. To understand the various text processing techniques in NLP.
3. To understand the role Text Classification, Deep Learning for Text Classification techniques of NLP.
4. Using Topic Modeling, Case Studies and apply the NLP techniques to IR applications.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the basic concepts of Natural language processing pipeline.
2. Implement various feature engineering and text representation techniques in NLP.
3. Illustrate text classification techniques to build NLP models.
4. Explore text summarization methods and example systems.
5. Develop strong problem solving skills by working on real world datasets and projects.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	2	2	2	2	2	3	2	2	1
CO2	2	3	3	3	2	2	2	2	3	3	2	3	2	2	1
CO3	2	3	2	3	2	2	2	2	2	2	2	3	2	2	1
CO4	2	3	2	3	2	2	2	2	3	2	2	3	1	1	1
CO5	2	3	3	3	2	2	2	2	3	3	2	3	1	1	2

List of Experiments:

1. Demonstrate the NLP Pipeline, Workflow of the NLP Project and NLP all libraries.
2. Implement preprocessing steps: Tokenization, Stop Word Removal, Stemming and lemmatization.
3. Develop an application to explore Text Representation techniques: One-hot encoding, Bag of Words, TF-IDF and N Gram.
4. Develop the word embedded techniques: Word2Vec and Glove.
5. Build a text classification with sentiment analysis: Apply the text preprocessing techniques and classification algorithms.
6. Implement the text classification with RNN: LSTM and GRU, CNN.
7. Implement the text classification with Attention: Self – Attention and Multi Head Attention.
8. Implement the Text classification with Transformers.
9. To Build a Text Summarization using NLP techniques.
10. To build a Text generation using NLP Techniques.

Text Books / Suggested Reading:

1. Steven Bird, Ewan Klein, and Edward Lope, Natural Language Processing with Python. O‟Reily, 2009.
2. Deep Learning for Natural Language Processing Develop Deep Learning Models for Natural Language in Python (Jason Brownlee), Machine Learning Mastery, 2017.
3. Lewis Tunstall, Leandro von Werra, Thomas Wolf - Natural Language Processing with Transformers_ Building Language Applications with Hugging Face-O'Reilly Media (2022).
4. Akshay Kulkarni, Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Apress, 2019.
5. Sudharsan Ravichandiran , Getting Started with Google BERT Build and train state-of-the-art natural language processing models using BERT.

Web Resources:

1. https://models.quantumstat.com/
2. https://www.coursera.org/learn/attention-models-in-nlp
3. https://github.com/keon/awesome-nlp

22CAE09

REINFORCEMENT LEARNING LAB

(Professional Elective-IV LAB)

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

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. Analyze TD learning and evaluate Eligibility traces using case studies.

Course Outcomes:

Upon sucessful completion of the lab, the students will be able to

1. Understand and implement basic concepts of reinforcemnt learning
2. Design and implement MDP using value and policy iteartions
3. Analyze and implement Monte Carlo Methods and TD learning algorithms
4. Apply and evaluate eligibility traces using case studies
5. Develop and implement RLalgorithms tosolve complex real world problems

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**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	-	-	1	-	-	-	2	-	1	2	2	2	1
CO2	3	3	3	2	2	1	-	-	1	-	1	2	2	3	1
CO3	2	3	2	3	2	1	-	2	1	-	1	2	2	3	1
CO4	2	2	2	3	3	-	-	2	1	-	3	2	1	2	1
CO5	2	2	3	3	3	-	-	3	1	-	3	2	1	2	2

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.

Text Books:

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.

Suggested Reading:

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.

Web Resources:

1. https://nptel.ac.in/courses/106106143
2. https://www.coursera.org/specializations/reinforcement-learning

22ADC16 **PROJECT PART–I**

Instruction	4 P Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of core engineering courses, Capable of searching for suitable literature, ProblemIdentification and Solving.

Course Objectives:

1. The student takes up investigative study in the broad field of Engineering / Technology, involving boththeoretical 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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	1	3	1	1	3	3	2	3
CO2	3	3	2	3	1	1	1	1	3	1	1	3	3	3	2
CO3	3	3	3	1	1	1	1	1	3	1	1	3	2	2	3
CO4	3	3	3	3	3	1	2	1	3	1	2	3	3	3	2
CO5	3	1	1	1	1	1	1	3	3	3	1	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.

22ADI02

INDUSTRIAL INTERNSHIP/ RURAL INTERNSHIP

Instruction/Demonstration/Training	4-6 Weeks/135 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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	-	3	-	3	3	2	2	3
CO2	1	1	1	3	3	-	2	1	-	-	-	-	3	3	2
CO3	2	3	3	3	3	2	3	1	1	-	-	-	3	3	3
CO4	-	-	-	-	-	3	-	1	3	3	-	1	2	2	3
CO5	1	3	3	3	3	2	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 asthe industry supervisor at least one day prior to avail leave.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2027-28)

B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

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.		Open Elective – 3	3	-	3	40	60	3
2.		Professional Elective – 5	3	-	3	40	60	3
PRACTICAL								
3.	22ADC19	Technical Seminar	-	2	-	50	-	1
4.	22ADC20	Project Part -II	08 Hours per week /180 Hours Industry -		-	100	100	4
			06	**02**	**06**	**230**	**220**	**11**
Clock Hours Per Week: 08								

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

Professional Elective #5	Cyber Forensic Analysis (22ADE31)	Social Network Analytics (22ADE32)	Robotic Process Automation (22CIE14)	Explainable Artificial Intelligence (22ADE33)	Soft Computing (22CAE01)

Open Elective #3	Engineering Leadership (22MBO04)	Introduction to Operations Research (22MEO04)	Research Methodologies and Innovation (22MEO05)	Strategic Entrepreneurship (22MBO02)	Indian Traditional Knowledge (22EGO03)

22MBO04

ENGINEERING LEADERSHIP

(Open Elective-III)

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 Behaviour.
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 behaviour 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	PO12
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	1	2	2	2	1	2
CO5		1	1	1	1	2	1	2	2	2	1	1

UNIT - I

Nature and Behaviour of leadership: Definitions of Leadership-Indicators of Leadership Effectiveness-Research Methods for Studying Leadership effectiveness-important Types of Leadership Behaviour-Specific Task Oriented Leader Behaviours- Specific Relations Oriented Leader Behaviours.

UNIT - II

The leadership Situation and Adaptive Leadership: Different ways Situations affect Leaders-Stewart Model of Situational Determinants-Other Situational Determinants of Leader Behaviour-Guidelines for Coping with Demands and Constraints-Early Contingency theories of Effective Leader Behaviour-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-III)

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 PERTtechniques.
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 projectssuccessfully.
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	PO12	PSO 1	PSO 2	PSO 3
CO 1	2	2	1	-	1	-	-	1	1	-	-	1			
CO 2	2	1	1	-	1	-	-	1	-	-	-	1			
CO 3	1	1	1	-	-	2	-	-	-	-	2	1			
CO 4	3	-	-	-	-	-	-	1	-	-	-	2			
CO 5	2	1	1	-	-	2	1	-	1	-	2	1			

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, earliestand 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 arrivalsexponential service times.

Text Books:

1. Hamdy A. Taha, Operations ResearchAn 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. PaneerSelvam, Operations Research, 2nd edition, PHI Learning Pvt. Ltd., New Delhi,2008.
2. Nita H. Shah, Ravi M. Gor, HardikSoni, Operations Research, PHI Learning Private Limited,2013.

22MEO05

RESEARCH METHODOLOGIES AND INNOVATION

(Open Elective-III)

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	PO12	PSO1	PSO2	PSO3
CO 1	1	2	1	1	-	1	-	-	1	2	2	2			
CO 2	-	2	1	2	1	1	-	1	1	3	2	2			
CO 3	1	2	3	2	2	1	-	-	1	2	-	1			
CO 4	2	2	-	3	2	-	-	-	-	2	1	1			
CO 5	2	2	3	2	3	1	-	-	-	-	-	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 hypothesistesting research studies, Basic Principles of Experimental Design, Steps in Sample design

UNIT – IV

Data Collection and Analysis: Collection of primary dataObservation, 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 Upagade 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-III)

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	PO12
CO 1	2	2	2	2	1	1	2	1	1	1	1	1
CO 2	1	2	2	2	2	1	1	1	1	1	1	1
CO 3	-	1	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	-	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-III)

Instruction	3L 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-PSO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2	1	1	2	3	3	2	2	1	2
CO 2	1	1	2	1	1	2	3	3	2	2	1	2
CO 3	1	1	2	1	1	2	3	3	2	2	1	2
CO 4	1	1	2	1	1	2	3	3	2	2	1	2
CO 5	1	3	2	1	1	2	3	3	2	2	2	3

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, Darshanas.

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.

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 Paranjepe, "Ancient Indian insight and Modern Science"**,** Bhandarkar Oriental Research Institute, 1996.
5. Pradeep Parihar, "Vedic World and Ancient Science", World House Book Publishing, 2021.

22ADE31

CYBER FORENSIC ANALYSIS

(Professional Elective- V)

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

Course Objective:

This course aims to:

1. Make students gain a foundational understanding of digital forensics
2. Ensure students learn to apply digital investigation techniques in various scenarios

Course Outcomes:

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

1. Identify and list the key components and tools required for a digital forensics' investigation.
2. Apply the best acquisition method for digital evidence, using appropriate tools and ensuring data integrity through validation.
3. Analyse digital evidence in various incident scenes and assess the effectiveness of the evidence collection process.
4. Use appropriate techniques and tools to detect hidden data within a digital environment, considering the context and nature of the investigation.
5. Use network tools within simulated environments to capture and analyse network traffic.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	-	2	3	1
CO2	3	3	2	2	3	-	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	3	2
CO5	3	2	2	2	3	-	-	-	-	-	-	-	2	3	2

UNIT-I

An Overview of Digital Forensics: A Brief History of Digital Forensics, Understanding Case Law, Developing Digital Forensics Resources. **Preparing for Digital Investigations**: Understanding Law Enforcement Agency Investigations, Following Legal Processes, Understanding Private-Sector Investigations, Digital Forensics Life Cycle. **Preparing a Digital Forensics Investigation**: An Overview of a Computer Crime, An Overview of a Company Policy Violation, Understanding Data Recovery Workstations and Software.

UNIT-II

Conducting an Investigation: Gathering the Evidence, Understanding Bit-stream Copies, Analysing Your Digital Evidence, Completing the Case, and Critiquing the Case. **Data Acquisition**: Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method,

Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Using Remote Network Acquisition Tools.

UNIT-III

Processing Crime and Incident Scenes: Identifying Digital Evidence, Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes, preparing for a Search, Securing a Digital Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash.

UNIT-IV

Digital Forensics Analysis and Validation: Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques. **Current Digital Forensics Tools:** Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools.

UNIT-V

Virtual Machine Forensics, Live Acquisitions, and Network Forensics: An Overview of Virtual Machine Forensics, Performing Live Acquisitions, Network Forensics Overview. **Mobile Device Forensics:** Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices.

Text Book:

1. "Guide to Computer Forensics and Investigations" by Bill Nelson, Amelia Phillips, Christopher Steuart, Sixth Edition, Cengage, 2019.

Suggested Readings:

1. "Digital Forensics with Open-Source Tools" by Cory Altheide and Harlan Carvey. © 2011 Elsevier Inc.
2. "Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes" by Albert J. Marcella Jr., Robert S. Greenfield, 1st Edition, 2002, Taylor & Francis group, Auerbach Publications.
3. "Practical Forensic Imaging: Securing Digital Evidence with Linux Tools" by Bruce Nikke, 2016, No Starch Press.

Web Resources:

1. https://www.sifs.in/course-details/cyber-forensics
2. https://www.udemy.com/course/digital-forensics-and-cyber-crime-investigation/?couponCode=LEADERSALE24B
3. https://www.sifs.in/course-details/cyber-forensics

22ADE32

SOCIAL NETWORK ANALYTICS

(Professional Elective- V)

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

Prerequisite:

1. A course on "Web Technologies";
2. A course on "Computer Networks";
3. A course on "Data Warehousing and Data Mining".

Course Objectives:

This course aims to:

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:

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

1. Design the social networks
2. Gain skills in tracking the social networks and its tools.
3. Use Open source tools to perform social network analysis.
4. Visualize social networks and analysis.
5. Predict human behavior in social network and related communities

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	3	2	-	-	3	2	1	3	1	1	1
CO 2	3	3	1	2	3	1	1	1	2	2	1	3	1	1	1
CO 3	3	2	2	2	3	1	-	-	1	2	-	3	3	2	1
CO 4	2	3	2	2	3	-	-	-	2	2	1	3	2	1	1
CO 5	3	2	3	2	3	1	-	-	2	2	1	3	2	1	1

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 Behavioral Sciences - Metrics in social network analysis.

UNIT - II

Social Network Analysis, Software Tools and Libraries: Data Representation, network measures, Modeling 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 Centers, 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.

UNIT - V

Predicting Human Behavior and Privacy Issues: Understanding and predicting human behavior 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.

Text Books:

1. David Eas ley, Jon Kleinberg, “Networks, Crowds and Markets”, Cambridge Press, 2010.
2. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.

Suggested Reading:

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 Sheiderman, Marc Smith, Analysing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.

Web Resources:

1. https://www.coursera.org/course/sna
2. https://www.coursera.org/course/networks

22CIE14

ROBOTIC PROCESS AUTOMATION

(Professional Elective- V)

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

Course Objectives:

1. To provide insights on robotic process automation (RPA) technology and its value proposition
2. To introduce different platforms for RPA
3. To learn different types of variables, control flow and data manipulation techniques
4. To familiarize with Image, Text and data Tables Automation
5. To describe various types of Exceptions and strategies to handle them.

Course Outcomes:

On Successful completion of the course, student will

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	PO12	PSO1	PSO2	PSO3
CO 1	1	2	2	2	-	-	-	-	-	-	-	1	1	2	1
CO 2	3	2	1	1	1	-	-	-	-	-	-	-	2	3	1
CO 3	3	2	1	2	1	-	-	-	-	-	-	-	1	2	1
CO 4	3	2	1	1	-	-	-	-	-	-	-	-	1	2	1
CO 5	2	2	1	2	1	-	-	-	-	-	-	-	1	1	1

UNIT – I

RPA Foundations- What is RPA - flavors 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 useData 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 eventsRevisit 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.

Textbook:

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

Web Reference:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

22ADE33

EXPLAINABLE ARTIFICIAL INTELLIGENCE (XAI)

(Professional Elective- V)

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. To impart knowledge 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. To 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. Evaluate model fairness through the implementation of Counterfactual Explanations (CFEs) using tools like WIT and Alibi to enhance transparency in AI models.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	1	1	1	1	2	3	1	3	3	2	3
CO2	2	2	2	2	1	1	2	1	2	2	1	3	3	2	3
CO3	3	2	2	1	1	2	1	1	2	1	1	3	3	2	3
CO4	2	3	2	1	1	2	1	1	2	1	1	3	3	2	3
CO5	2	3	1	2	1	2	1	1	2	1	1	3	3	2	3

UNIT – I

Introduction to Explainable Artificial Intelligence Artificial Intelligence, Need for XAI, Explainability vs. Interpretability. **Explainability Types:** Intrinsic explanation, Post-hoc explanation, Model specific, Model agnostic, Local interpretation, Global interpretation, Sublocal interpretation,

Textual explanations, Visual explanations. **Tools for Model Explainability:** SHAP, LIME, Skater, Skope_rules. 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, NonLinear Model Explanation – LIME, Non-Linear Explanation – Skope-Rules

UNIT – IV

Explainability for Ensemble Models 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

Text Books:

1. Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks Pradeepta Mishra, Apress
2. Hands-On Explainable AI (XAI) with Python: Interpret, visualize, explain, and integrate reliable AI for fair, secure, and trustworthy AI apps by Denis Rothman

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

22CAE01

SOFT COMPUTING

(Professional Elective- V)

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

Prerequisites: Artificial Intelligence & Machine Learning

Course Objectives:

1. Acquire the fundamental knowledge in soft computing.
2. Understand the basics of fuzzy sets and fuzzy logic rules.
3. Discuss the basics of genetic algorithms
4. Analyze the fundamentals of artificial neural network models.

Course Outcomes:

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

1. Identify artificial intelligence and soft computing techniques in building intelligent machines.
2. Apply fuzzy logic and reasoning to handle uncertainty.
3. Understand different operators and basic terminologies of genetic algorithms
4. Understand the concept of artificial neural networks.
5. Evaluate different soft computing techniques for suitable applications.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	1	-	1	2	2	3	3	2
CO2	2	3	2	2	-	-	-	1	-	2	-	2	3	3	1
CO3	2	1	1	2	-	-	-	1	-	1	-	2	2	2	1
CO4	2	1	1	2	-	-	-	1	-	2	-	2	3	3	2
CO5	2	1	2	2	-	1	-	1	1	2	2	2	2	2	1

UNIT- I

Introduction to Soft Computing: Introduction, Hard Computing vs Soft Computing, Soft Computing Constituents, Machine Learning Basics: Supervised, Unsupervised and Reinforcement Learning. **Introduction to Fuzzy Logic:** Classical Sets (Crisp Sets) Theory: Basic Definitions and Terminology, Operations, Properties, Crisp Relations and Operations, Fuzzy Sets Theory: Operations, Fuzzy Relations and compositions, Types of Membership Functions, Features.

UNIT - II

Fuzzy Logic and Inference rules: Introduction, Classical Logic, Multi-valued Logic, Fuzzy Logic, Fuzzy Propositions, Inference Rules for Fuzzy Propositions. **Fuzzy Inference Systems:** Introduction, Fuzzy Inference System (Fuzzification, Defuzzification), Types of Fuzzy Inference Engines and its Implementation, Neuro Fuzzy System.

UNIT - III

Introduction to Evolutionary Computing: Biological Evolutionary Process, Paradigms, Strategies, Evolutionary Programming, Advantages and applications**. Genetic Algorithm Process:** GA Introduction, Selection, Encoding of Genetic Operators, Classification of GA, Applications, Advantages and Disadvantages of GA.

UNIT - IV

Single Layer Feed Forward Neural Networks: Introduction, Biological Neurons, Artificial Neural Networks, ANN Model, Single Layer Feed forward Neural Network, Applications of NN.**Multi-Layer Feed Forward Neural Networks:** Architecture, Learning Methods, Backpropagation Method, Design Issues of ANN, and Applications.

UNIT V

Radial Basis Function Neural Networks (RBNF): RBNF Introduction, Architecture, Learning, Comparison of RBNF and FFNN(Feed Forward Neural Networks), and Applications.**Recurrent Neural Networks:** RNN Architecture and Training, Hopfield Networks, Self-Organizing Neural Networks.

Text Books:

1. Saroj Kaushik, Sunita Tiwari, Soft Computing Fundamentals, Techniques and Applications, McGraw Hill, 2018.

Suggested Reading:

1. Elaine Rich, Kevin Knight and Shivashankar B.Nair, Artificial Intelligence, 3rd Edition TMH, 2009, rp2017.
2. Jyh:Shing Roger Jang, Chuen:Tsai Sun and Eiji Mizutani, Neuro Fuzzy and Soft Computing, Prentice Hall of India/PHI, 2003.
3. Amit Konar, Artificial Intelligence and Soft Computing- Behavioural and Cognitive Modelling of the Human Brain, CRC press, 1st Edition, Taylor and Francis Group, 1999.
4. Hung T Nguyen and Elbert A Walker, A first course in Fuzzy Logic, CRC Press, 3rd Edition, Taylor and Francis Group, 2006.
5. Fakhreddine Karray and Clarence D Silva, Soft Computing and Intelligent System Design, Pearson Edition, 2004.

Web Resources:

1. http://www.myreaders.info/html/soft_computing.html.
2. https://onlinecourses.nptel.ac.in/noc22_cs54/preview

22ADC19

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	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	3	1	2	2	2	3	3	3	3
CO2	0	2	2	1	1	3	3	1	1	3	2	3	2	0	1
CO3	3	2	2	2	1	3	3	0	1	2	1	3	3	3	3
CO4	3	2	2	2	1	3	3	0	1	2	1	3	2	0	1
CO5	3	2	1	1	2	3	3	0	1	3	2	3	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 3rd week to the last week of the semester and any change in schedule shall bediscouraged.

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

22ADC20 **PROJECT PART-II**

Instruction	08 Hours per Week
Duration of SEE	--
SEE	100 Marks
CIE	100 Marks
Credits	4

Course Objectives:

1. Enable the student extend further the investigative study, either fully theoretical/practical or involving boththeoretical and practical work.
2. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointlywith a Supervisor drawn from R&D laboratory/Industry.
3. Preparing an Action Plan for conducting the investigation, including team work.

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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	2	2	3	3	2	1	3
CO2	3	3	2	3	3	2	2	2	2	2	3	2	3	2	1
CO3	3	3	3	2	2	2	2	1	1	1	2	2	2	1	2
CO4	3	2	3	2	2	2	2	1	2	3	2	2	2	2	2
CO5	3	2	2	1	1	2	2	2	3	3	2	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**
Departme ntReview Committe e	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead topublications
	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 andInternal 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