UG-R22 Curriculum
With effective from 2022-23

Artificial Intelligence and Machine Learning

Scheme of Instruction and Syllabi of
B.E I to VIII Semester of
Four Year Degree Course

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institute | Affiliated to Osmania University)
Accreditated by NBA & NAAC (A++)
Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.
E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in
Phone No. : 040-24193276 / 277 / 279

SCHEME OF INSTRUCTION AND SYLLABI

Of

B.E. I to VIII SEMESTERS

FOR

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

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

(R–22 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad– 500 075. Telangana

E-Mail: principal@cbit.ac.in; Website: www.cbit.ac.in;

Phone Nos.: 040-24193276 / 277 / 279

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF AIML

PROGRAMME: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

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 produce professionals in artificial intelligence and machine learning through the best possible education, acquire international recognition as a destination, and advance society in exciting and creative ways.

Mission:

• Impart rigorous training to generate knowledge through the state-of-the-art concepts and technologies in Artificial Intelligence and Machine Learning.
• Develop technical proficiency in students through creativity and leadership.
• Encourage lifelong learning, social responsibility, environmental conservation, and professional ethics.
• Establish centres of excellence in leading areas of computer and artificial intelligence disciplines.

PROGRAM EDUCATION OBJECTIVES (PEOs):

PEO 1: Work effectively in inter-disciplinary field with the knowledge of Artificial Intelligence and Machine Learning to develop appropriate solutions to real-world problems.

PEO 2: Excel in their professional careers and pursues advanced study in the area of machine learning and artificial intelligence.

PEO 3: Use ongoing education to apply their expertise to the technology transformation.

PEO 4: Excel as socially responsible engineers or entrepreneurs with high moral and ethical standards.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO 1: Ability to evaluate and apply knowledge of data engineering, artificial intelligence, machine learning, and human cognition to real-world issues in order to solve potential challenges.

PSO 2: Ability to acquire computational knowledge and project development abilities using novel tools and methodologies to tackle challenges in the fields related to Deep Learning, Machine learning, Artificial Intelligence.

PSO 3: Capacity to direct a team or firm that develops products and to use the knowledge learned to recognize actual research issues.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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

B.E. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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	0	3	40	60	4
2	22PYC01	Optics and Semiconductor Physics	3	0	0	3	40	60	3
3	22CSC01	Problem Solving And Programming	2	1	0	3	40	60	3
4	22EGC01	English	2	0	0	3	40	60	2
PRACTICAL									
5	22PYC03	Optics and Semiconductor Physics Lab	0	0	3	3	50	50	1.5
6	22EGC02	English lab	0	0	2	3	50	50	1
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC01	CAD AND DRAFTING	0	1	3	3	50	50	2.5
9	22MEC38	Digital Fabrication Lab	0	0	3	3	50	50	1.5
TOTAL			**10**	**3**	**14**	**27**	**410**	**490**	**20**

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

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

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

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

CO-PO ARTICULATION MATRIX

PO/PSO CO	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	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, KhannaPublishers, 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

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

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

COURSE OBJECTIVES: 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 completion of this course, students 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

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

SUGGESTD 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.

22CSC01

PROBLEM SOLVING AND PROGRAMMING

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. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

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

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data.
6. Handle data using files.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	-	1	-	-	-	-	-	-	1
CO2	3	1	1	-	1	-	-	-	-	-	-	1
CO3	3	1	1	-	1	-	-	-	-	-	-	1
CO4	3	1	1	-	1	-	-	-	-	-	-	1
CO5	3	1	1	-	1	-	-	-	-	-	-	1
CO6	3	1	1	-	1	-	-	-	-	-	-	1

UNIT I

Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II

Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III

Conditional Statement, Loops, Arrays and Strings, user-defined Data Types – if, else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV

Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V

File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.

3. Mark Lutz, “Learning Python”, 5th Edition, O'Reilly Media, Inc.
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM COURSES:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming

22EGC01

ENGLISH

Instruction	2 L 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 completion of this course, students 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

PO/PSO CO	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	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 READING:
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

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

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

COURSE OBJECTIVES: 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 completion of this course, students 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

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

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

PREREQUISITE: Basic Knowledge of English Communication.

COURSE OBJECTIVES: This course aims to

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To IELTS and TOEFL 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 completion of this course, students 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 IELTS and TOEFL 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

PO/PSO CO	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	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

LIST OF 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 IELTS and TOEFL material.
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 e presentation.

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. Priyadarshi Patnaik, “Group Discussions and Interviews”, Cambridge University Press Pvt. Ltd., 2011.
4. Aruna Koneru, “Professional Speaking Skills”, Oxford University Press, 2016.

22CSC02

PROBLEM SOLVING AND PROGRAMMING 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. Master the fundamentals of writing Python scrips.
2. Learn Python elements such as variables, flow controls structures, and functions.
3. Discover how to work with lists and sequence data, and files.

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

1. Understand various Python program development Environments.
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	3	3	2	2	3	-	-	-	-	-	-	1
CO3	2	3	3	2	3	-	-	-	-	-	-	1
CO4	2	3	3	2	2	-	-	-	-	-	-	1
CO5	2	3	3	3	3	-	-	-	-	-	-	1
CO6	2	3	3	3	3	-	-	-	-	-	-	1

LABORATORY / PRACTICAL EXPERIMENTS:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Courses:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming.

22MEC01

CAD AND DRAFTING

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

COURSE OBJECTIVES: This course aims to

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

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

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO ARTICULATION MATRIX

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

LIST OF EXERCISES:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
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
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. 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.

22MEC38

DIGITAL FABRICATION 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. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive &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, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & 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: After 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

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

LIST OF EXERCISES:

GROUP-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.

a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch

b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket

4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.
6.

a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.

b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

GROUP- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students 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.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.

Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Inline with AICTE Model Curriculum with effect from AY 2022-23

B.E. ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SEMESTER – II

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination	Maximum Marks		Credits
			Hours per Week			Duration of SEE in Hours	CIE	SEE	
			L	T	P/D				
THEORY									
1	22MTC04	Differential Equations & Numerical Methods	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC03	Object Oriented Programming	2	1	0	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3	3	50	-	1.5
7	22CSC04	Object-Oriented Programming Lab	0	0	2	3	50	50	1
8	22MEC37	Robotics & Drones Lab	0	2	2	-	100	-	3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
TOTAL			**10**	**5**	**12**	**24**	**460**	**390**	**21**

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

CIE - CIE **SEE – Semester End Exam**

22MTC04

DIFFERENTIAL EQUATIONS & NUMERICAL METHODS

(AI&ML)

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

COURSE OBJECTIVES: This course aims to

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 completion of this course, students will be able to

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

CO-PO ARTICULATION MATRIX

PO/PSO CO	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	3	-	-	-	-	-	-	-	2	1	1	-
CO 2	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO 3	2	2	2	2	-	-	-	-	-	-	-	1	2	2	-
CO 4	2	2	2	2	-	-	-	-	-	-	-	1	2	2	-
CO 5	1	1	1	1	-	-	-	-	-	-	-	1	1	1	-

UNIT - I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Interpolation and Numerical Differentiation: Forward, Backward and Central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Lagrange 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
(COMMON TO CSE, CSE-AIML, AIML, CSE-IOT, AIDS)

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. 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, nanomaterials and basic drugs of modern chemistry is essential.

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

At the end of the course 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

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

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism -Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides), Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:

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

UNIT-V Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

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 READING:

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).

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	3 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 completion of this course, students 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

PO/PSO CO	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	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

22CSC03

OBJECT ORIENTED PROGRAMMING

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

COURSE OBJECTIVES: This course aims to

1. Explore the concepts object-oriented programming like classes, constructors, Polymorphism, Inheritance, and File handling.
2. Prepare student for solving real-world problems using OOPs concepts.

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

1. Understand the concepts of Object-Oriented features.
2. Apply OOPs concepts and different libraries to solve programming problems.
3. Understand the advanced concepts of Python.
4. Develop programs to access databases and web data.
5. Understand APIs and third-party libraries to be used with Python.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	2	-	1	-	-	-	-	-	-	1
CO2	3	1	3	2	2	-	-	-	-	-	-	2
CO3	3	1	2	1	1	-	-	-	-	-	-	1
CO4	3	2	3	1	2	-	-	-	-	-	-	2
CO5	3	2	3	1	2	-	-	-	-	-	-	2

UNIT I:

Introduction to Object Oriented Programming Paradigms - Programming paradigms, advantages of OOP, comparison of OOP with Procedural Paradigms; Classes and Objects: Prototyping, referencing the variables in functions, inline, static functions, Memory allocation for classes and objects, arrays of objects, constructors.

UNIT II:

Polymorphism and Inheritance: Overriding methods, type conversions, base classes and derived classes, types of inheritance, various types of classes, invocation of constructors and destructors inheritance, aggregation, composition, classification hierarchies, metaclass/ abstract classes, unit testing and exceptions.

UNIT III:

Python Libraries -Basics of Open Source libraries for data pre-processing, modeling and visualization.

UNIT IV:

Python to access Web Data - Regular Expressions, extracting data, sockets, using the Developer Console to Explore HTTP, Retrieving Web Page, and Passing Web Pages.

UNIT V:

Using Databases with Python - Using Databases, Single Table CRUD, Designing and representing a data model, reconstructing data with JOIN, many-to-many relationships.

TEXT BOOKS AND REFERENCES:

1. Allen Downey, Jeff Elkner, Chris Meyers, “How to Think Like a Computer Scientist: Learning with Python”, SoHo Books, 2009.
2. R.S. Salaria, “Mastering Object-Oriented Programming”, 6th Edition, Khanna Book Publishing Co., Delhi.
3. Jeeva Jose, “Introduction to Computing & Problem Solving with Python”, First Edition, Khanna Book Publishing, 2019.
4. Paul Barry, “Head First Python”, O′Reilly, 2010.

NPTEL/SWAYAM COURSES:

1. Python for Data Science, Prof. Raghunathan Rengasamy, IIT Madras.
2. The Joy of Computing using Python Prof. Sudarshan, Prof. Yayati Guptaingar, IIT Ropar, IIIT Dharwad.
3. https://www.coursera.org/specializations/python-3-programming#courses.

22CYC02

CHEMISTRY LAB
(Common to CSE, CSE-AIML, AIML CSE-IOT, AIDS)

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

COURSE OBJECTIVES: This course aims to
1. To 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 theorical concepts in the preparation of new materials like drugs and polymers.

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

CO-PO ARTICULATION MATRIX

PO/PSO CO	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	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 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.

22MBC02

COMMUNITY ENGAGEMENT

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

COURSE OBJECTIVES: The main Objectives of this Course are 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. Utilize the opportunities provided by Rural Development Programmes.

Module I

Appreciation of Rural Society

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

Module II

Understanding Rural Economy and Livelihood

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

Module III

Rural Institutions

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

Module IV

Rural Development Programmes

History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, 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).

22CSC04

OBJECT-ORIENTED PROGRAMMING 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. Master the concepts of Object Oriented Programming.
2. Explore the OOPs features of Python and build applications.

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

1. Demonstrate the features of Object-Oriented Programming.
2. Understand APIs and third-party libraries to be used with Python.
3. Use Python libraries to solve real-world problems.
4. Write scripts to solve data science/machine leaning problems using NumPy and Pandas.
5. Develop applications by accessing web data and databases.

CO-PO ARTICULATION MATRIX

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

LABORATORY / PRACTICAL:

1. Demonstration of classes and objects with referencing the class variables, instance variables and static variables.
2. Demonstration of Inheritance types with constructor and destructor invocation in inheritance.
3. Demonstration of Exception handling and unit testing.
4. Write a NumPy program to compute the cross product of two given vectors.
5. Write NumPy program to calculate the QR decomposition of a given matrix.
6. Write a Pandas program to convert a Panda Module Series to Python list and its type.
7. Write a Pandas program to convert a NumPy array to a Pandas series.
8. Create a Python project to get the citation from Google scholar using title and year of publication and volume and pages of journal.
9. Create a Python project to get total COVID-19 cases, total deaths due to Covid-19, total Covid-19 patients recovered in the world.
10. Demonstration of database connectivity and different types of JOIN operations on tables.

Note: Programs need to be on OOPS concepts.

TEXT BOOK:

1. Reema Thareja, "Python Programming", First Edition, Oxford Press, 2017.

ONLINE RESOURCES:

1. https://vknight.org/cfm/labsheets/04-object-oriented-programming/
2. http://learning-python.com/class/Workbook/x-exercises.htm
3. https://inst.eecs.berkeley.edu/~cs61a/fa14/lab/lab06/#inheritance
4. https://anandology.com/python-practice-book/object_oriented_programming.html
5. http://stanfordpython.com/
6. https://docs.python.org/3/

22MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

COURSE OUTCOMES: After completion of course, students would be able to:

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

COURSE ARTICULATION MATRIX

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

LAB EXPERIMENTS:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function
11. Assembly of a drone

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: At the end of the course, the students are expected 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 Matrix

PO/PSO CO	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	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.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

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

B.E. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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	22CSC05	Data Structures	3	0	0	3	40	60	3
2	22CSC11	Database Management Systems	3	0	0	3	40	60	3
3	22CSC32	Discrete Mathematics	3	0	0	3	40	60	3
4	22MBC01	Engineering Economics and Accountancy	3	0	0	3	40	60	3
5	22ECC38	Analog and Digital Electronics	3	0	0	3	40	60	3
6	22MEC39	Design Thinking	3	0	0	3	40	60	3
PRACTICAL									
7	22CSC31	Data Structures Lab	0	0	2	3	50	50	1
8	22CSC33	Database Management Systems Lab	0	0	2	3	50	50	1
9	22MEC40	Design Thinking Lab	0	0	2	3	50	50	1
10	22AMI01	MOOCs/ Training/ Internship	0	0	3-4 w or 90 hrs	-	-	50	2
TOTAL			**18**	**0**	**10**		**390**	**560**	**23**

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

CIE - CIE **SEE – Semester End Examination**

22CSC05

DATA STRUCTURES

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

PRE-REQUISITES: Basic knowledge of programming language such as python.

COURSE OBJECTIVES: This course aims to
1. Study various linear and non-linear data structures.
2. Understand the performance of operations on data structures.
3. Explore various searching and sorting techniques.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand the basic concepts and types of data structures.
2. Analyze various linear and nonlinear data structures.
3. Identify the applications of linear and nonlinear data structures and significance of balanced search trees, hashing.
4. Evaluate various searching and sorting techniques.
5. Use appropriate data structures to design efficient algorithms.

CO-PO ARTICULATION MATRIX

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

UNIT-I

Introduction: Data structures, Classification of data structures, Abstract Data Types, Analysis of Algorithms; **Recursion**: Examples illustrating Recursion (Factorial, Binary Search), Analyzing Recursive Algorithms; **Sorting:** Quick sort, Merge Sort, Selection Sort, Radix sort, Comparison of Sorting Algorithms.

UNIT–II

Stacks: Stack ADT, Applications of stack, Array based stack implementation**; Queues:** Queue ADT, applications of queues, Array based queue implementation, Double Ended Queues, Circular queues.

UNIT-III

Linked Lists: Introduction, Linked lists, Representation of linked list, types of linked list, singly linked lists, implementing stack with a singly linked list and Queue, Circular linked lists, doubly linked lists, Applications of linked lists.

UNIT-IV

Trees: General Trees, Binary Trees, Implementing Trees, Tree traversals; **Search Trees:** Binary Search Trees, Balanced search trees- AVL trees, B- trees; **Priority Queue and Heaps:** Priority queue ADT, Priority queue applications, Heap Trees, implementing a priority queue with a Heap, Heap Sort.

UNIT-V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals.

Hashing: Introduction, Hash Functions-Modulo, Middle of Square, Folding, Collision Resolution Techniques-Separate Chaining, Open addressing,- Linear Probing, Quadratic Probing, Double Hashing.

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020
3. S. Sahni and Susan Anderson-Freed, “Fundamentals of Data structures in C”, E. Horowitz, Universities Press, 2nd Edition.
4. Reema Thareja, “Data Structures using C”, Oxford University Press, 2nd Edition, 2014.

SUGGESTED READING:

1. D. S. Kushwaha and A K. Misra, “Data structures A Programming Approach with C”, PHI, 2nd edition, 2014.
2. Seymour Lipschutz, “Data Structures with C”, Schaums Outlines, MGH, Kindle Edition, 2017.
3. Kenneth A. Lambert, " Fundamentals of Python: Data Structures", Cengage Learning, 2018
4. D. Samantha, “Classic Data Structures”, Prentice Hall India, 2nd Edition, 2013

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-#DS
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

22CSC11

DATABASE MANAGEMENT SYSTEMS

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

PRE-REQUISITES: Discrete mathematics of computer science, 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: After completion of this course, students will be able to

1. Design database schema for an application using RDBMS concepts.
2. Write SQL queries for tasks of various complexities.
3. Build applications using database system as backend.
4. Understand internal working of a DBMS including data storage, indexing, query processing, transaction processing, concurrency control and recovery mechanisms.
5. Analyse non-relational and parallel/distributed data management systems with a focus on scalability.

CO-PO ARTICULATION MATRIX

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

UNIT - I

Introduction: Motivation, Introduction to Data Models (Relational, Semi structured, ER).
Relational Data Bases: Relational Data Model, Relational Algebra, Relational Calculus.

UNIT - II

SQL + Interaction with Database: 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. Index Definition in SQL.
Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Subqueries, Views), Programming in a standard language and interfacing with a DB backend.

UNIT- III

Big Data: Key-value Stores and Semi structured Data, using JSON and MongoDB, or other combinations
Database Design: Introduction to ER model, Mapping from ER to relational model, Functional Dependencies, Normalization.

UNIT - IV

Physical Design: Overview of Physical Storage (Hard Disks, Flash/SSD/RAM), sequential vs random I/O, Reliability via RAID, Storage Organization (Records, Pages and Files), Database Buffers, Database Metadata, Indexing, B+-Trees.

UNIT - V

Query Processing and Optimization: Query Processing, External sort, Joins using nested loops, indexed nested loops.

Overview of Query Optimization: Equivalent expressions and concept of cost based optimization.
Transaction Processing: Concept of transactions and schedules, ACID properties, Conflict-serializability, C**oncurrency control:** locks, 2PL, Strict 2PL, optional: isolation levels, Recovery using undo and redo logs.

TEXT BOOKS:

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill. Indian Edition, 2021
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Pubs, 2017
3. Lemahieu, Broucke and Baesens, "Principles of Database Management", Cambridge University Press, 2018
4. 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

ONLINE RESOURCES:

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html.
2. https://www.oracle.com/news/connect/json-database-semistructured-sql.html

22CSC32

DISCRETE MATHEMATICS

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

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

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

CO-PO ARTICULATION MATRIX

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

UNIT – I

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

UNIT – II

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

UNIT – III

Generating Functions: Generating Functions, Calculating Coefficient of generating functions.
Recurrence Relations: The First Order Linear Recurrence Relation, Second Order Linear. Homogeneous Recurrence relations with constant coefficients, Non Homogeneous Recurrence relations.

UNIT – IV

Introduction to Graphs: Graphs and their basic properties- degree, path, cycle, Sub graphs, Complements and Graph Isomorphism, Euler trails and circuits, Hamiltonian paths and cycles, planar graphs, Euler formula, Graph Coloring.
Trees: Definitions, Properties, Spanning Trees, Minimum Spanning trees: The Algorithms of Kruskal and Prims

UNIT - V

Algebraic Structures: Algebraic Systems, Examples and General Properties, Semi groups and Monoids. Groups: Definitions and Examples, Subgroups, Homomorphisms and cyclic groups.

TEXT BOOKS:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics- An Applied Introduction", 5th Edition, Pearson Education, 2016.
2. Rosen, K. H. (2019). Discrete Mathematics and Its Applications. (8th Edition) ISBN10: 125967651X ISBN13: 9781259676512.
3. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", TATA Mc Graw-Hill Edition, 1995.

SUGGESTED READING:

1. Singh, S.B., Discrete Mathematics, Khanna Book Publishing Company, New Delhi. SBN: 9789382609407, 9789382609407, 3rd Edition, 2019
2. R. K. Bisht, H. S. Dhami, "Discrete Mathematics", Oxford University Press, Published in 2015.
3. David D. Railey, Kenny A. Hunt, "Computational Thinking for the Modern Problem Solving", CRC Press, 2014
4. Joe L. Mott, Abraham Kandel, Theodore P. Baker, "Discrete Mathematics for Computer Scientists & Mathematicians", 8th Edition, PHI, 1986

ONLINE RESOURCES:

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

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

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

COURSE OBJECTIVES: This course aims to

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

COURSE OUTCOMES: After completion of this course, students 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

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

22ECC38

ANALOG AND DIGITAL ELECTRONICS

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

PREREQUISITE: Knowledge of Electronic device concepts.

COURSE OBJECTIVES: This course aims to:
1. Learn basic concepts and working principles of analog devices.
2. Learn various techniques for logic minimization.
3. Comprehend the concepts of various combinational circuits and sequential circuits.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand the basic concepts related analog devices and digital circuits.
2. Design the combinational and sequential circuits.
3. Examine the behavior of logic gates.
4. Analyze the behavior of the digital system design.
5. Evaluate the performance of real time combinational circuits and sequential circuits.

CO-PO ARTICULATION MATRIX

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

UNIT -I

Devices: Concepts of semiconductors, V-I Characteristics of P-N Junction diode, current equation. Characteristics of Zener Diodes, Special diodes: LED, Photo Diode.

Applications: Zener Diode as a voltage regulator, Half Wave Rectifier and Full Wave Rectifier.

UNIT-II

Bipolar Junction Transistors: Classification, Operation of Bipolar Junction Transistor, Configurations: CB, CE Characteristics, Applications.

Field Effect Transistor: Junction Field Effect Transistor: Principle of Operation, Characteristics of JFET, parameters and Operation of MOSFET

UNIT-III

Boolean Algebra and Logic Simplification: Number system representation and conversion, Binary Arithmetic, Complements, Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to all Logic Gates, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT-IV

Introduction to Combinational Design: Binary Adders, Subtractors, Code converters Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display, Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers.

UNIT-V

Sequential Logic Design: Latches, Flipflops, Difference between latch and flipflop, types of flipflops like S-R, D, T JK and Master-Slave JK FF, flipflop conversions, Ripple and Synchronous counters, Shift registers.

TEXT BOOKS:

1. Robert L.Boylestad, Louis Nashelsky, "Electronic Devices and Circuits Theory", Pearson Education, 9th Edition, LPE, Reprinted, 2006.
2. Morris Mano M. and Michael D.Ciletti, "Digital Design, With an Introduction to Verilog HDL", 5th Edition, Pearson 2013.

SUGGESTED READING:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th Edition, 2009.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson, 11th Edition, 2015.

22MEC39

DESIGN THINKING

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

COURSE OBJECTIVES: This course aims to

1. Create awareness of design thinking approaches
2. Identify a systematic approach for defining/identifying a problem
3. Create design thinking teams and conduct design thinking sessions collaboratively
4. Apply both critical thinking and design thinking in parallel to solve problems
5. Motivate to apply design thinking concepts to their real life scenarios

COURSE OUTCOMES: At the end of the course, the students are able to

1. Empathize on the needs of the users
2. Define the problems for stimulating ideation
3. Ideate on problems to propose solutions by working as a design thinking team
4. Prototype and test the proposed solutions focusing on local or global societal problems

CO-PO ARTICULATION MATRIX

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

UNIT – I

Introduction to Engineering & Thinking: Engineering for social and economic development; impact of science/engineering. Thinking and behaviour; Types of thinking – Linear thinking, lateral thinking, systems thinking, design thinking.

Introduction to Design Thinking: Importance of Design Thinking & Human centric approach – Phases in design thinking process, five-stage model as iterative method, applications of design thinking in various domains.

UNIT – II

Empathize phase: Understanding the unique needs of the user, empathize with the users, steps in empathize phase, developing empathy towards people, assuming a beginner's mind-set (what? why?), steps in immersion activity, body storming; Case studies.

UNIT – III

Define phase: Define the problem and interpret the result, analysis and synthesis, Personas – Four different perspectives on Personas, steps to creating personas, problem statement, affinity diagrams, empathy mapping; Point of View – "How might we" questions, Why-how laddering; Case studies.

UNIT – IV

Ideation phase: What is ideation, need, uses, ideation methods; Brainstorming, rules for brainstorming; Mind maps, guidelines to create mind maps; Ideation games; Six Thinking Hats; Doodling, use of doodling in expressing creative ideas; Case studies.

UNIT – V

Prototyping phase: Types of prototyping, guidelines for prototyping, storytelling, characteristics of good stories, reaching users through stories, importance of prototyping in design thinking; Value proposition, guidelines to write value proposition; Case studies.

Testing phase: Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase.

TEXT BOOKS:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2. Michael Luchs, Scott Swan, Abbie Griffin, Design thinking: New product development essentials from the PDMA. John Wiley & Sons, 2015.
3. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India Private Limited, 2020.

SUGGESTED READING:

1. Jeanne Liedtka, Andrew King, Kevin Bennett, Solving problems with design thinking: Ten stories of what works. Columbia University Press, 2013.
2. Bala Ramadurai, Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Edition 1, 2020.

22CSC31

DATA STRUCTURES LAB

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

PRE-REQUISITES: Any Programming Language.

COURSE OBJECTIVES: This course aims to
1. Understand the basic concepts of data structures and abstract data types.
2. Explore linear and non-linear data structures.
3. Study various searching, sorting and hashing techniques.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Implement the abstract data type.
2. Implement linear and non-linear data structures.
3. Evaluate various sorting techniques.
4. Analyze various algorithms of linear and nonlinear data structures.
5. Choose or create appropriate data structures to solve real world problems.

CO-PO ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:
1. Implementation of Quick sort, Merge sort and Selection sort.
2. Implementing Stack using array.
3. Conversion of Infix expression to Postfix expression.
4. Implement the algorithm for Evaluation of Postfix.
5. Implementing Queues using array
6. Implementation of Insert, Delete and Display operations on Single Linked List.
7. Implementation of Stack and Queue using linked list.
8. Implementation of Insert, Delete and Display operations on doubly Linked List.
9. Implementation of Binary Search Tree operations.
10. Implementation of Heap Sort.

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020.

22CSC33

DATABASE MANAGEMENT SYSTEMS LAB

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

COURSE OBJECTIVES: This course aims to

1. Become familiar with the concepts of structured query language.
2. Understand about programming language / structured query language (PL/SQL).
3. Become familiar with generation of form and open database connectivity.
4. Add constraints on Databases implement DCL, TCL and advanced SQL commands.
5. Develop programs using cursors, triggers, exceptions, procedures and functions in PL/SQL.

COURSE OUTCOMES: After 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 SQL operators.
2. Demonstrate Queries to Retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, Save point commands, SQL Plus Reports and formulate the Queries for Creating, Dropping and Altering Tables, Views, constraints.
4. Develop queries using Joins, Sub-Queries and Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update, Creating Password and Security features.
5. Develop PL/SQL code using Cursors, Exception, Composite Data Types and Procedures, Functions and Packages.

CO-PO ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:

SQL:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using operators in SQL.
3. Queries to Retrieve and Change Data: Select Insert, Delete and Update.
4. Queries using Group By, Order By and Having Clauses.
5. Queries on Controlling Data: Commit, Rollback and Save point.
6. Queries to Build Report in SQL *PLUS.
7. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
8. Queries on Joins and Correlated Sub-Queries.
9. Queries on Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update,
10. Creating Password and Security features.
11. Querying in NoSql

PL/SQL:

1. Write a PL/SQL code using Basic Variable, Anchored Declarations and Usage of Assignment Operation.
2. Write a PL/SQL code Bind and Substitution Variables, Printing in PL/SQL.
3. Write a PL/SQL block using SQL and Control Structures in PL/SQL.

4. Write a PL/SQL code using Cursors, Exception and Composite Data Types.
5. Write a PL/SQL code using Procedures, Functions and Packages.

Note: The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

TEXT BOOKS / SUGGESTED READING:

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

22MEC40

DESIGN THINKING LAB

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

COURSE OBJECTIVES: This course aims to

1. Create awareness of design thinking approaches
2. Identify a systematic approach for defining/identifying a problem
3. Create design thinking teams and conduct design thinking sessions collaboratively
4. Apply both critical thinking and design thinking in parallel to solve problems
5. Motivate to apply design thinking concepts to their real life scenarios

COURSE OUTCOMES: At the end of the course, the students are able to

1. Understand the key principles of design thinking and apply in problem solving.
2. Empathize on the needs of the customers and use human centric approach in developing solutions.
3. Develop and apply customer journey maps for proposing innovative solutions.
4. Ideate on problems to propose solutions by working in collaboration.
5. Test the proposed solutions by focusing on local or global societal problems through prototyping.

CO-PO ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:

1. Innovation exercises for thinking outside the box.
2. Creating a persona step by step for guiding design thinking process.
3. Creating customer Journey Maps
4. How might we …? Exercise.
5. Exercise on Ideation Matrix – creative matrix.
6. Creating Idea Napkin.
7. Six Thinking Hats.
8. Testing the concepts using prototypes.
9. Advanced exercises in 3D printing.
10. Open ended exercise: Proposing innovative solutions to simple problems related to a product /service.

TEXT BOOKS:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India Private Limited, 2020.
3. Christian Müller-Roterberg Hochschule Ruhr West, Handbook of Design Thinking, Kindle Direct Publishing ISBN: 978-1790435371, November 2018

SUGGESTED READING:

1. Jeanne Liedtka, Andrew King, Kevin Bennett, Solving problems with design thinking: Ten stories of what works. Columbia University Press, 2013.
2. Bala Ramadurai, Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human Centered Products & Services, Edition 1, 2020.

22AMI01

INTERNSHIP-I
(MOOCs/Training/Internship)

Instruction	3 to 4 weeks or 90 hours
CIE	50 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. Exposing the students to the industrial environment and technologies
2. Provide possible opportunities to learn, make them 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 completion of this course, students will be able to

1. Learn new technologies and solve real time projects.
2. Expose to the industrial environment problems and technologies
3. Gain knowledge on contemporary technologies industrial requirements.
4. Identify , Design and Develop solutions for real world problems
5. Communicate their ideas and learning experiences through reports and presentation.

CO-PO ARTICULATION MATRIX

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

PROCESS TO BE FOLLOWED FOR CARRYING OUT INSTRUCTIONS TO STUDENTS:

1. Students may apply for internships through the AICTE Portal or through CDC of the institute by filling 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 (**15marks**)
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)

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

B.E. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

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	22AMC01	Computer Architecture and Microprocessor	3	0	0	3	40	60	3
2	22AMC02	Principles of Artificial Intelligence	3	0	0	3	40	60	3
3	22AMC03	Introduction to Machine Learning	3	0	0	3	40	60	3
4	22AMC08	Agile Software Development	3	0	0	3	40	60	3
5	22CSC15	Operating Systems	3	0	0	3	40	60	3
6	22MTC13	Mathematical Foundation for Data Science and Security	3	0	0	3	40	60	3
PRACTICAL									
7	22AMC04	Principles of Artificial Intelligence Lab	0	0	3	3	50	50	1.5
8	22AMC05	Introduction to Machine Learning Lab	0	0	3	3	50	50	1.5
9	22AMC09	Principles of Operating Systems Lab	0	0	2	3	50	50	1
10	22MTC14	Mathematical Foundation for Data Science and Security Lab	0	0	2	3	50	50	1
TOTAL			**18**	**0**	**10**		**440**	**560**	**23**

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

CIE - CIE **SEE – Semester End Examination**

22AMC01

COMPUTER ARCHITECTURE AND MICROPROCESSOR

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

PRE-REQUISITES: Analog and digital circuits.

COURSE OBJECTIVES: This course aims to

1. To understand the basic principles of Instruction Level Architecture and Instruction Execution, Memory System Design.
2. To learn various I/O devices and its operations, knowledge on Instruction Level Parallelism.
3. To impart the knowledge on Micro Programming and Pipelining techniques.

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

1. Understand the functional block diagram of single bus architecture of a computer, and the process of performing arithmetic operations.
2. Comprehend the 8086 microprocessor architecture.
3. Design assembly language programs using 8086 instruction set.
4. Analyze memory transfer operations and performance enhancement using pipelining,
5. Interpret the working of memory system and Large computer systems.

CO-PO ARTICULATION MATRIX

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

UNIT - I

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance, Multiprocessors and Multi-computers.

Arithmetic: Addition and Subtraction of Signed numbers, Design of fast adders, Multiplication of positive numbers, Signed-Operand Multiplication, Integer Division.

UNIT - II

Basic Processing Unit: Fundamental concepts, Execution of a complete instruction, Multiple-Bus organization, Hardwired control, Microprogrammed control.

8086 Architecture: CPU Architecture, Internal operation, Machine language instructions, Addressing modes.

UNIT- III

Assembly Language Programming: Instruction format, Instruction execution timing. Data transfer instructions, Arithmetic instructions.

Branch instructions, Loop instructions, NOP and HLT, Flag manipulation instructions, Logical instructions, Shift and Rotate instructions, Directives and Operators. Procedures, Interrupts and Interrupt routines, Macros.

UNIT - IV

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers– Program Controlled, Interrupt Driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes role of interrupts in process state transitions, I/O device interfaces– SCSI, USB.

Pipelining: Basic concepts, Data hazards, Instruction hazards, Structural hazard. Influence on instruction sets, Data path and control considerations.

UNIT – V

The Memory System: Memory hierarchy, Semiconductor RAM Memories, Cache Memories, Performance considerations, Virtual Memories, Memory Management requirements, Secondary Storage.

Large Computer Systems: Forms of Parallel Processing, Array Processors, Structure of general-purpose multiprocessors, Program parallelism and shared variables.

TEXT BOOKS:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", 5th Edition, McGraw Hill Education Edition2011.
2. Yu-chengLiu, Glenn A.Gibson, "Microcomputer Systems: The 8086/ 8088 Family", 2nd Edition, PHI Learning 2011.

SUGGESTED READING:

1. M. M. Mano, "Computer System Architecture", 3rdedition, Prentice Hall, 1994.
2. William Stallings, "Computer Organisation and Architecture, Design for Performance", Pearson, 9th Edition, 2013.
3. Douglas Hall. "Microprocessor and Interfacing programming and Hardware", Tata McGraw Hill, Revised 2nd Edition, 2007.
4. Brey B. Brey, "The Intel Microprocessor, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro-Processors-Architecture, Programming and Interfacing", 4thEdition, Prentice Hall.

22AMC02

PRINCIPLES OF ARTIFICIAL INTELLIGENCE

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

PRE-REQUISITES: Data structures, Discrete Mathematics, Probability Theory.

COURSE OBJECTIVES: The objectives of this course are

1. To list the significance of AI.
2. To discuss the various components that is involved in solving an AI problem.
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. Explain 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. Compare and contrast the various knowledge representation schemes of AI.
4. Appraise probabilistic reasoning and model building
5. Apply Markov decision Process to solve real world Problems.

CO-PO ARTICULATION MATRIX

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

UNIT - I

Introduction: Foundations of AI, History, State of the Art, Risks and Benefits.
Intelligent agents: Agents and Environment, The Concept of Rationality, Structure of an Agent.
Solving problems by Search- Problem-Solving Agents, State space representation, Search graph and Search tree Searching for Solutions,

UNIT - II

Uninformed Search Strategies: Uniform cost search, Iterative deepening Depth-first search, Bidirectional search**.**
Informed (Heuristic) Search Strategies: Heuristic Functions, Hill- climbing, Greedy best-first search, A* search, Simulated Annealing search.

UNIT – III

Adversarial Search: Game Theory, Alpha–Beta Pruning, Constraint Satisfaction Problems.
Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau, Predicate Logic, Resolution Refutation in Propositional Logic and Predicate Logic

UNIT - IV

Knowledge Representation: Introduction, approaches to knowledge Representation, Knowledge Representation using Semantic Network, Knowledge Representation using Frames.
Probabilistic Reasoning: Probability, inference using full joint distributions, Bayes rule, Bayesian networks-representation, construction, exact and approximate inference, temporal model, hidden Markov model.

UNIT – V

Markov Decision process: MDP formulation, utility theory, multi attribute utility functions, decision networks, sequential decision problems value iteration, policy iteration partially observable MDP.

TEXTBOOKS:

1. Russell, Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 4th Edition, 2020.
2. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, First Edition, 2011.

SUGGESTED READING:

1. Rich, Knight, Nair, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition 2009.
2. Trivedi. M.C., “A classical approach to Artificial Intelligence”, Khanna Publishing House, Delh

ONLINE RESOURCES:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

22AMC03

INTRODUCTION TO MACHINE LEARNING

Instruction	3 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 Concepts of Machine Learning.
2. To study various machine learning techniques.
3. To design solutions for real world problems using machine learning techniques.

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

1. Define the basic concepts related to Machine Learning.
2. Describe the Feature Engineering Methods and Regression techniques.
3. Comparison between Supervised and Unsupervised Learning.
4. Classification of algorithms.
5. Applying Machine Learning techniques to real world problems.

CO-PO ARTICULATION MATRIX

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

UNIT-I

Introduction to Machine Learning: Introduction, Well-Posed Learning Problems, Types of Learning, Perspectives and Issues in Machine Learning.

Concept Learning: Concept Learning Task, Concept learning as Search: General to Specific Ordering of Hypothesis, Find-S: Finding Maximally Specific Hypothesis, Candidate Elimination Algorithm.

UNIT-II

Feature Engineering: Introduction to Features and need of Feature Engineering, Feature Extraction and Selection.

Regression: Linear Regression, Multivariate Regression, Regression Types: Ridge, Lasso, Elastic Net.

UNIT-III

Naïve Bayes and Discriminant Analysis: Naïve Bayes Classifiers, Discriminant Analysis.

Ensemble Learning: Introduction to Ensemble Learning-Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier.

Instance-based Learning: Logically Weighted Regressions, Radial Basis functions, Linear SVM, K-means, Evaluation methods, DBSCAN.

UNIT-IV

Unsupervised Learning: Clustering, types of clustering, K-Means clustering, Hierarchical clustering, Birch Algorithm, CURE Algorithm, Principal Component Analysis (PCA), Principal Component Regression (PCR).

Classification Algorithms: KNN, Linear Classification, Logistic Classification.

Reinforcement Learning: Introduction, Q-Learning.

UNIT-V

Neural Network: Neural network –gradient descent, Activation functions, Parameter initialization, convolutional neural networks, recurrent neural networks, Introduction to Recommender System.

TEXT BOOKS:

1. Abhishek Vijavargia “Machine Learning using Python”, BPB Publications, 1st Edition, 2018.
2. Giuseppe Bonaccorso, “Machine Learning Algorithms”, 2nd Edition, Packt, 2018.
3. Tom Mitchel “Machine Learning”, Tata McGraw Hill, 2017.

SUGGESTED READING:

1. Abhishek Vijavargia “Machine Learning using Python”, BPB Publications, 1st Edition, 2018.
2. Marsland, S.”Machine Learning: An Algorithmic Perspective” 1st Edition, Chapman and Hall/CRC, 2009.https://doi.org/10.1201/9781420067194.
3. Reema Thareja “Python Programming”, Oxford Press, 2017.
4. Yuxi Liu, “Python Machine Learning by Example”, 2nd Edition, PACT, 2017.

ONLINE RESOURCE:

1. https://www.guru99.com/machine-learning-tutorial.htm
2. https://www.tutorialspoint.com/machine_learning _with_python/index.htm
3. https://www.tutorialspoint.com/python/
4. https://docs.python.org/3/tutorial/
5. https://www.geeksforgeeks.org/machine-learning/

22AMC08

AGILE SOFTWARE DEVELOPMENT

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

PRE-REQUISITES: Data structures, Design Thinking

COURSE OBJECTIVES: This course aims to

1. Demonstrate the ability to participate effectively in Agile Process for Software Development.
2. Explain the Purpose behind common Agile practices.
3. Apply Agile Principles and Values to a given real time problem.

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

1. Interpret the concept of agile software engineering and its advantages in software development.
2. Analyse the core practices behind several specific agile methodologies.
3. Identify the roles and responsibilities in agile projects and their difference from projects following traditional methodologies.
4. Access implications of functional testing, unit testing, and continuous integration.
5. Determine the role of design principles in agile software design.

CO-PO ARTICULATION MATRIX

PO/PSO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	2	2	2	1	-	2	2	2	1	1	2	2	2	2	2
CO 2	2	2	2	2	-	2	2	2	1	1	2	2	2	2	2
CO 3	2	1	2	1	-	2	2	2	2	2	2	2	1	1	2
CO 4	2	2	1	1	-	2	1	2	2	2	2	2	1	1	2
CO 5	2	1	3	1	-	2	2	2	2	2	2	2	2	1	2

Unit I

Introduction: Need of Agile software development, agile context– Manifesto, Principles, Methods, Values, Roles, Artifacts, Stakeholders, and challenges. Business benefits of software agility.

Unit II

Project Planning: Recognizing the structure of an agile team– Programmers, Managers, Customers. User stories– Definition, Characteristics and content. Estimation– Planning poker, Prioritizing, and selecting user stories with the customer, projecting team velocity for releases and iterations.

Unit III

Project Design: Fundamentals, Design principles–Single responsibility, Open-closed, Liskov substitution, Dependency-inversion, Interface-segregation.

Unit IV

Design Methodologies: Need of scrum, Scrum practices –Working of scrum, Project velocity, Burn down chart, Sprint backlog, Sprint planning and retrospective, Daily scrum, Scrum roles– Product Owner, Scrum Master, Scrum Team. Extreme Programming- Core principles, values and practices. Kanban, Feature-driven development, Lean software development.

Unit V

Testing: The Agile lifecycle and its impact on testing, Test driven development– Acceptance tests and verifying stories, writing a user acceptance test, Developing effective test suites, Continuous integration, Code refactoring. Risk based testing, Regression tests, Test automation.

TEXT BOOKS:

1. Ken Schawber, Mike Beedle, “Agile Software Development with Scrum”, International Edition, Pearson.
2. Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, First International Edition, Prentice Hall.
3. Pedro M. Santos, Marco Consolaro, and Alessandro Di Gioia, “Agile Technical Practices Distilled: A learning journey in technical practices and principles of software design”, First edition, Packt Publisher.

REFERENCE BOOKS:

1. Lisa Crispin, Janet Gregory, “Agile Testing: A Practical Guide for Testers and Agile Teams”, International edition, Addison Wesley.
2. Alistair Cockburn, “Agile Software Development: The Cooperative Game”, 2nd Edition, Addison-Wesley

E-BOOKS AND ONLINE LEARNING MATERIAL:

1. “The Complete Guide to Agile Software Development” https://clearbridgemobile.com/complete-guide- agile-software-development/
2. “Agile Fundamentals Ebook: A Complete Guide for Beginners”, https://agileken.com/agile- fundamentals-ebook/

ONLINE COURSES AND VIDEO LECTURES:

1. “Agile Software Development”, https://www.edx.org/course/agile-software-development Accessed on August 27, 2021.
2. “Agile Software Development”, https://www.coursera.org/learn/agile-software-development Accessed on August 27, 2021.

22CSC15

OPERATING SYSTEMS

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

PRE-REQUISITES: 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: After 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 Apply security as well as recovery features in the design Operating system.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-		1	1
CO 2	3	3	-	3	1	-	-	-	-	-	-	-	1	1	1
CO 3	3	3	2	1	1	-	-	-	-	-	-	-	1	2	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, 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, 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, RAID levels.

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: Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

TEXT BOOKS:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. Maurice J. Bach, "Design of the UNIX Operating System", Pearson Education India; 1st Edition, 2015.
3. Ekta Walia Khanna, "Operating System Concepts", Publishing House; 2nd Edition, 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" Pearson Education India; 3rd Edition, 2013.

ONLINE 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)

22MTC13

Mathematical Foundation for Data Science & Security (AIML)

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

COURSE OBJECTIVES: This course aims to

1. Able to learn and Analyzing data in Linear and Non-Linear form.
2. Able to fit the hypothetical data using probability distribution.
3. To know the characteristics of various continuous probability distributions.
4. To discuss the testing of hypothesis of sample data.
5. To know the security issues of Cryptography.

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

1. Analyze the coefficient of skewness and fitting of the data by various methods.
2. Apply properties of Mathematical Expectations and analyze the various distributions.
3. Evaluate areas of curves by using various distributions.
4. Apply various tests for testing the significance of sample data.
5. Apply RSA –PKC for solving security issues.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO2	3	3	2	3	-	-	-	-	-	-	-	2	1	1	-
CO3	3	3	2	3	-	-	-	-	-	-	-	2	1	1	-
CO4	3	3	3	3	-	-	-	-	-	-	-	2	1	1	-
CO5	3	3	2	3	-	-	-	-	-	-	-	2	1	1	-

UNIT-I: Basic Statistics

Measures of Central Tendency, Measures of Dispersion, Moments (Moments about the mean and moments about a point). Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, coefficient of correlation, limits of correlation coefficient. Linear Regression, Regression coefficients, Properties of Regression Coefficients. Curve fitting by the Method of Least Squares, Fitting of Straight lines and Exponential curve.

UNIT-II: Mathematical Expectation and Discrete Probability Distribution

Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, properties of variance. Poisson distribution, MGF and Cumulates of the Poisson distribution, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution)

UNIT-III: Continuous Probability Distributions

Normal distribution, Characteristics of normal distribution and Normal probability Curve, MGF and CGF of Normal distribution, Areas under normal curve. Uniform distribution, Moment generating function, Mean and Variance of uniform distribution. Exponential distribution, MGF, CGF, Mean and Variance of Exponential distribution.

UNIT-IV: Testing of Hypotheses

Test of significance, null and alternative hypotheses, Errors in sampling, level of significance. Large sample test: Test of significance for single proportion, difference of proportions, single mean and difference of means. Small Sample Tests: T-Test for single mean, differences of Means. F- test for equality of two population variances. Chi-Square test of Goodness of fit.

UNIT-V: Number Theory & CRYPTOGRAPHY (RSA – PKC)

Division Algorithm, Greatest Common Divisor, Euclidean Algorithm, Wilson's Theorem, Euler's Phi-Function, Euler's Theorem, Some Properties of the Phi-Function. The RSA public key cryptosystem, Implementation and security issues, Pollard's $p-1$ factorization algorithm, Quadratic Residues and quadratic reciprocity.

TEXT BOOKS:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Burton, David M. (2007) Elementary Number Theory (7^{th}edu.). Tata McGraw Hill Edition, Indian Reprint
3. Mathematical Cryptography by Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman Springer Science+ Business Media LLC.

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. Koshy, T.Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
4. G.A.Jones & J.M.Jones "Elementary Number Theory", Springer UTM, 2007.

22AMC04

PRINCIPLES OF ARTIFICIAL INTELLIGENCE LAB

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

PRE-REQUISITES: Programming Basics, Probability and Statistics.

COURSE OBJECTIVES: This course aims to

1. To design and analyze 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 the course, students will be able to,

1. Understand the basic components of library environment and installations.
2. Analyze the design heuristics and apply various techniques to solve real world problems.
3. Apply variety of algorithms to solve problems.
4. Identify how to use GitHub and submit back genuine contributions.
5. Implement problems using game search algorithms.

CO-PO ARTICULATION MATRIX

PO/PSO / CO	PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO 1	2	2	2	2	3	-	-	2	2	2	1	3	3	2	2
CO 2	3	3	3	3	3	1	2	2	2	2	1	3	3	3	3
CO 3	3	3	3	3	3	2	1	2	2	2	1	3	3	3	3
CO 4	3	2	3	3	3	2	1	2	1	2	1	3	3	3	1
CO 5	3	3	2	3	3	3	1	2	2	2	1	3	3	3	3

LIST OF EXPERIMENTS:

1. Design/construct the workflow of a general AI project using draw.io
2. Implement Water Jug Problem using A* search
3. Implement an 8-puzzle solver using Heuristic search technique.
4. Implement the Constraint Satisfaction problem using backtracking.
5. Implement a program for game search.
6. Implement a Bayesian network from a given data and infer the data from that Bayesian network.
7. Implement a MDP to run value and policy iteration in any environment.
8. Build a bot to build any game using easy AI libraries
9. Understanding of GitHub and Anaconda environments.
10. Use the GitHub packages and libraries to frame a standard project and commit back to GitHub.

TEST BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2010.
2. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, 2011.

SUGGESTED READING:

1. Trivedi, M.C., “A Classical Approach to Artificial Intelligence”, Khanna Publishing House, Delhi, 2018.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition, 2017.

ONLINE 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.html

22AMC05

INTRODUCTION TO MACHINE LEARNING LAB

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

COURSE OBJECTIVES: This course aims to

1. To make use of Data sets in implementing the machine learning algorithms.
2. To implement the machine learning concepts and algorithms.
3. To use real world data and implement machine learning models.

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

1. Identify the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Identify and utilize modern tools that are useful for data analysis.
3. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Implement and evaluate various Machine Learning approaches on real world problems.
5. Apply Keras and Tensorflow to implement ML techniques.

CO-PO ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:

1. Identification and Installation of python environment towards the machine learning, installing python modules/Packages Import scikitlearn, keras and tensorflows etc.
2. Build linear regression model using gradient descent, least squares, polynomial, LASSO and RIDGE approaches also compare all the algorithms and draw a table for all the metrics.
3. Demonstration of decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build the decision tree classifier compare its performance with ensemble techniques like random forest, bagging, boosting and voting Demonstrate it with different decision trees.
5. Build FIND-S and Candidate-Elimination algorithm on a different data set.
6. Demonstration of Logistic Regression for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for your dataset.
7. Demonstration of Naïve Bayesian classifier for a sample training data set stored as a .CSV file.
8. Implementation of Gradient Descent Algorithm using Tensorflow.
9. Case study on supervised learning algorithms.
10. Demonstration of clustering algorithms- k-Means, Agglomerative and DBSCAN to classify for the standard datasets.

TEXT BOOKS:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt Publishing, 2017.

ONLINE RESOURCES:

1. http://www.cs.cmu.edu/~tom/
2. http://www.holehouse.org/mlclass/

22AMC09

PRINCIPLES OF OPERATING SYSTEMS LAB

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

PRE-REQUISITES: Programming for problem solving.

COURSE OBJECTIVES: This course aims to
1. To explore Unix/Linux operating system.
2. To analyze various system calls available in Linux/Unix.

COURSE OUTCOMES: After completion of this course, students will be able to,
1. Understand Linux/Unix environment.
2. Understand and implement shell programming.
3. Simulate memory management and file allocation techniques.
4. Analyze process and file management system calls by creating and/or modifying concurrent programs.
5. Build network-oriented applications using system calls.

CO-PO ARTICULATION MATRIX

PO/PSO CO	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	2	-	-	-	2	-	-	-	-	-	-	-	1	1	1
CO 3	2	-	2	-	-	-	-	-	-	-	-	-	1	2	1
CO 4	2	2	2	1	-	-	-	-	-	-	-	-	1	1	1
CO 5	2	1	1	1	-	-	-	-	-	-	-	-	1	1	1

LIST OF EXPERIMENTS:
1. Shell programming.
2. Demonstration and Performance Evaluation of CPU scheduling algorithms
3. Implementation of memory management techniques like paging and segmentation.
4. Implementation of Linked, Indexed and Contiguous file allocation methods.
5. Demonstration of Linux/Unix file related system calls: mkdir, link, unlink, mount, unmount, users+, chown, chmod, open, close, read, write, lseek, stat, sync.
6. Implementation of producer-consumer, readers- writers and dining philosophers problem using semaphores
7. Demonstration of Bankers Algorithm for Deadlock Avoidance.
8. Development of applications using Linux/Unix system calls: signal, socket, accept, snd, recv, connect.

TEXT BOOKS:

1. Galvin, Silberschatz, “Operating System Concepts”, 10th Edition, John Wiley & Sons, 2018.
2. Dhananjay Dhamdhare, “Operating Systems-A Concept Based Approach”, 3rd Edition, McGraw Hill Education, 2017.

SUGGESTED READING:

1. Ekta Walia, “Operating System Concepts”, Khanna Book Publishing, 2020.
2. William Stallings, “Operating Systems Internals and Design Principles”, Pearson Ed., 2012.
3. Charles Crowley, “Operating Systems –A Design Oriented Approach”, McGraw Hill Education, 2017.
4. Andrew S. Tanenbaum, Albert S Woodhull, “Operating systems Design and Implementation”, Pearson Ed., 2009.

22MTC14

MATHEMATICAL FOUNDATION FOR DATA SCIENCE & SECURITY (LAB)
R- PROGRAMMING (AIML)

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 know the graphical visualizations for the data.
2. To learn the measures of central tendency and dispersion.
3. To learn and analyze data in linear and non-linear form.
4. To learn the probabilities of various distributions.
5. To know the various cryptographic schemes for the encryption and decryption.

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

1. Create graphs and charts for the statistical data.
2. Analyze the data set using measures of central tendency and dispersion.
3. Develop the linear and non-linear regression models for the statistical data.
4. Evaluate the probabilities of various discrete and continuous distributions.
5. Demonstrate RSA – PKC technique of number theory for solving security issues.

CO-PO ARTICULATION MATRIX

PO/PSO CO	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	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
CO 2	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
CO 3	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
CO 4	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
CO 5	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-

LIST OF PROGRAMS:

1. Write a Program to create Graphs and Charts.
2. Write a Program to calculate the measures of Central Tendency for the data.
3. Write a Program to compute measures of disposition for the data.
4. Write a Program for Correlation and Covariance using Pearson method.
5. Write a Program for simple linear Regression and Logistic regression.
6. Write a Program to compute probabilities using Binomial 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 for hypothesis testing
10. Write a Program to compute gcd of any two positive integers using Euclidian algorithm.
11. Write a Program to encrypt the given data, using RSA algorithm.
12. Write a Program to decrypt the given data, using RSA algorithm

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2024-25

B.E.-Artificial Intelligence &Machine Learning

SEMESTER – V

S. No	Course Code	Category	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
				Hours per Week			Duration ofSEE in Hours	Maximum Marks		
				L	T	P/D		CIE	SEE	
THEORY										
1	22CAC01	PCC	Image Processing	3	-	-	3	40	60	3
2	22AMC10	PCC	Optimization Techniques for Machine Learning	3	-	-	3	40	60	3
3	22CAC04	PCC	Deep Learning	3	-	-	3	40	60	3
4	22CSC14N	PCC	Design and Analysis of Algorithms	3	-	-	3	40	60	3
5	22**E**	PEC	Professional Elective – I	3	-	-	3	40	60	3
6	22**O**	OE	Open Elective-I	3	-	-	3	40	60	3
PRACTICAL										
7	22CAC02	PCC	Image Processing Lab	-	-	3	3	50	50	1.5
8	22AMC11	PCC	Optimization Techniques for Machine Learning Lab	-	-	3	3	50	50	1.5
9	22CAC05	PCC	Deep Learning Lab	-	-	3	3	50	50	1.5
10	22CSC17	PCC	Design and Analysis of Algorithms Lab	-	-	3	3	50	50	1.5
11	22AMI02		Industrial / Rural Internship	3-4 week / 90 Hours			-	50	-	2
TOTAL				**18**	**0**	**12**	**-**	**490**	**560**	**26**

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

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

PE1 (T) Semester-V		Open Elective-I Semester-V	
22CAE02	Knowledge Representation and Reasoning	22CEO01	Infrastructure for Smart Cities
22CSE08	User Interface and User Experience Design	22MBO05	Engineering Leadership
22ADE29	Computer Vision	22ECO02	Remote Sensing and GIS
22ADE34	Information Retrieval Systems	22MEO06	Principles of Entrepreneurship and Startups

22CAC01

IMAGE PROCESSING

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

Pre-requisites: Signal Processing

Course Objectives: The objectives of this course are
1. To introduce basics of visual perception, sampling, quantization and representation of Digital images.
2. To introduce spatial domain and frequency domain filtering techniques necessary for Image processing operations.
3. To learn advanced image analysis techniques such as image restoration, image Compression, image segmentation.
4. To learn techniques of multi resolution methods, wavelets and morphological Processing.
5. To understand the applications of image processing

Course Outcomes: After completion of course, students would be able to:
1. Understand the basic image enhancement techniques in spatial & frequency domains.
2. Understand the basics of multi-resolution techniques.
3. Understand the basics of segmentation methods.
4. Apply this concept for image handling in various fields.
5. Knowledge about Morphological operations.

CO-PO Articulation Matrix:

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

UNIT-I

Fundamentals of Image Processing: Introduction, examples, fundamental steps, components, elements of visual perception, light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels. **Intensity Transformations and Spatial Filtering**: Background, some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods.

UNIT-II

Filtering in the Frequency Domain: Background, preliminary concepts, sampling and Fourier transform of sampled functions, discrete Fourier transform (DFT) of one variable, extension to functions of two variables, some properties of the 2-D discrete Fourier transform, basics of filtering in the frequency domain, image smoothing, image sharpening, homo- morphic filtering.

UNIT-III

Image Restoration: Noise models, restoration in the presence of noise only-spatial filtering,periodic noise reduction by frequency domain filtering, linear degradation, position-invariant degradation, estimating the degradation function, inverse filtering, minimum mean square error filtering, constrained least squares filtering, geometric mean filter.

UNIT-IV

Wavelets and Multi Resolution Processing: Background, multi-resolution expansions, wavelet transforms in one dimension, the fast wavelet transform, wavelet transforms in two dimensions, wavelet packets**. Image Compression**: Fundamentals, image compression models, elements of information theory, error free compression, lossy compression, image compression standards.

UNIT-V

Image Segmentation: Fundamentals, point, line and edge detection, thresholding, region-based segmentation, segmentation using morphological watersheds, the use of motion in segmentation. **Morphological Image Processing**: Preliminaries, erosion and dilation, opening and closing, the Hit-or-Miss transformation, some basic morphological algorithms, some basic gray-scale morphological algorithms.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. Rafael C.Gonzalez, Richard E.Woods and Steven L.Eddins, Digital Image Processing Using MATLAB,2nd Edition, McGraw Hill, 2010.

Suggested Reading:

1. AL. Bovik, The Essential Guide to Image processing, 2 nd Edition, Elsevier, 2009.
2. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI, 2006.
3. William K. Pratt, Digital Image Processing, John Wiley & Sons, Inc., 3rd Edition, 2001

Online Resources:

1. https://www.youtube.com/watch?v=DSGHkvQBMbs&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7En-WGX8
2. https://archive.nptel.ac.in/courses/117/105/117105135/

22AMC10

OPTIMIZATION TECHNIQUES FOR MACHINE LEARNING

Instruction	3 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 Optimization Techniques Fundamentals.
2. Understand various Local and Global Optimization Techniques.
3. Understand various Gradient descent optimization in machine learning.
4. Understand usage of stochastic methods and Optimization for Neural Networks.
5. Understand various applications of Optimization for Machine learning.

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

1. Understand the fundamentals of optimization, manipulate and analyse of the optimization.
2. Demonstrate key concepts from Machine learning for Optimization to describe Optimization functions.
3. Demonstrate the Optimization with Local and Global.
4. Make use of the Gradient Descent and Stochastic Optimization Algorithms.
5. Understand different applications of Machine learning for Optimization.

CO-PO Articulation Matrix:

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

Unit- I

Introduction to optimization: Introduction, History, Optimization Process, Constraints, Critical Points, Conditions for Local Minima, Derivatives and Gradients, Local Descent.

Basics of Linear Algebra and Calculus

Subspaces, Eigenvalue Decomposition and Singular Value Decomposition

Unit- II

Machine learning for Optimization

What is Function Optimization, Optimization and Machine Learning, How to Choose an Optimization Algorithm, No Free Lunch Theorem for Machine Learning, Local Optimization vs. Global Optimization, Premature Convergence, Creating Visualization for Function Optimization.

Unit- III

Local Optimization

What is a Gradient in Machine Learning? Univariate Function Optimization, Pattern Search: Nelder-Mead Optimization Algorithm, Second Order: The BFGS and L-BFGS-B Optimization Algorithms.

Global Optimization

Simple Genetic Algorithm, Evolution Strategies, Differential Evolution and Simulated Annealing.

UNIT-IV

Gradient Descent

Gradient Descent Optimization, Gradient Descent with Momentum, Gradient Descent with AdaGrad, Gradient

Descent with RMSProp, Gradient Descent with Adadelta, Adam Optimization Algorithm.
Stochastic Optimization Algorithms: Introduction, Stochastic Hill Climbing, Iterated Local Search, Random Search and Grid Search.

UNIT-V

Case Study on Machine learning for optimization:

Use Optimization Algorithms to Manually Fit Regression Models, Optimize Neural Network Models, Feature Selection using Stochastic Optimization and Optimize Machine Learning Model Hyperparameters.

Text Books / Suggested Reading:

1. Mykel J. Kochenderfer and Tim A. Wheeler, Algorithms for Optimization, MITPress,2019
2. Optimization for Machine Learning (Jason Brownlee), Machine Learning Mastery.
3. Linear Algebra and Learning from Data, Gilbert Strang.
4. Optimisation for Machine Learning by Suvrit Sra, MIT Press.

Online Resources:

Optimisation for Machine Learning: Theory and Implementation
https://onlinecourses.nptel.ac.in/noc23_cs64/preview

22CAC04

DEEP LEARNING

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

Pre-requisites: Calculus, Probability and Statistics, Python Programming, 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
CO1	3	2	1	1	2	1	1	1	1	1	1	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2
CO3	3	3	3	3	3	1	1	1	2	2	2	3
CO4	3	3	3	3	3	1	1	1	2	2	2	3
CO5	3	3	3	3	3	1	1	1	2	2	2	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.

Online 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/

22CSC14N

DESIGN AND ANALYSIS OF ALGORITHMS

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

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	1	-	-	-	-	-	-	-	-	-
CO 2	3	3	2	-	-	-	-	-	-	-	-	-
CO 3	2	2	2	-	-	-	-	-	-	-	-	-
CO 4	2	2	1	-	-	-	-	-	-	-	-	-
CO 5	2	2	1	-	-	-	-	-	-	-	-	-
CO 6	2	3	1	-	-	-	-	-	-	-	-	-

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", MIT Press/McGraw-Hill, 4rd Edition, 2022.
2. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2008.

Suggested Reading:

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

Online Resources:

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

22CAE02

KNOWLEDGE REPRESENTATIONS AND REASONING
(Professional Elective – I)

Instruction	3 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.

Objectives:

1. To understand the key concepts of knowledge representation and reasoning.
2. To explore the role of logic in knowledge representation.
3. To study ontology and its categories, including philosophical background and top-level categories.
4. To learn about knowledge representations, including knowledge engineering and representing structure in frames.
5. To examine processes, including times, events, situations, and computation, in knowledge representation.

Course Outcomes:

1. Ability to explain the key concepts of knowledge representation and reasoning.
2. Proficiency in representing knowledge in logic and understanding different varieties of logic.
3. Understanding of ontology, including ontological categories and how to describe physical entities and define abstractions.
4. Competence in representing knowledge structures in frames, rules, and data.
5. Ability to apply knowledge representation techniques to address real-world problems involving vagueness, uncertainty, and randomness

CO-PO Articulation Matrix:

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

UNIT-I: The Key Concepts: Knowledge, Representation, Reasoning, why knowledge representation and reasoning, Role of logic
Logic: Historical background, representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT-II: Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time

UNIT-III: Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

UNIT-IV: Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT-V: Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition

Text Books:

1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning.
2. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106140/

22CSE08

USER INTERFACE AND USER EXPERIENCE DESIGN
(Professional Elective – I)

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

Pre-requisites: Fundamental Computer Skills, Knowledge of Web Technologies.

Course Objectives:
This course aims to:

1. Familiarize students with the fundamental principles and concepts of user interface (UI) and user experience (UX) design.
2. Equip students with the practical skills and knowledge necessary to design effective UI/UX interfaces.
3. Understand the importance of applying user-centered design methods throughout the design process.

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

1. Apply user-centered design principles to create interfaces that meet the needs and preferences of target users.
2. Demonstrate proficiency in designing intuitive user interfaces that are easy to navigate and understand.
3. develop the skills to create wireframes, prototypes, and mockups using industry-standard design tools.
4. Gain an understanding of accessibility guidelines and principles, designing interfaces that are accessible to users with disabilities.
5. Identify emerging trends and technologies in UI/UX design.

CO-PO Articulation Matrix:

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

UNIT - I
Introduction to UI/UX Design: Understanding UI/UX Design: Definition and importance of UI/UX design, Difference between UI and UX, Roles and responsibilities of UI/UX designers, Overview of the design process. **User-Centered Design Principles**: Principles of user-centered design, User research methods (interviews, surveys, observations), Creating user personas and scenarios, Conducting user journey mapping exercises.

UNIT – II
Design Fundamentals: Basic principles of visual design (layout, typography, color),Gestalt principles and their application in UI design, Applying visual hierarchy to improve user experience, Introduction to design tools (Sketch, Figma, Adobe XD) **Interaction Design**: Principles of interaction design, Designing effective navigation systems,Feedback mechanisms and user affordances Prototyping techniques for interaction design.

UNIT - III
Usability and User Testing: Understanding usability principles, Nielsen's heuristics for user interface design, Conducting heuristic evaluations of UI designs, Usability testing methods (moderated vs. unmoderated, remote testing).
User Testing and Feedback: Planning and conducting usability tests, Analyzing usability test results Incorporating user feedback into UI design iterations, Best practices for iterative design and testing cycles.

UNIT - IV
Accessibility in UI/UX Design: Understanding accessibility guidelines (WCAG),Designing accessible interfaces for users with disabilities, Assistive technologies and their impact on UI/UX design

Emotional Design and Engagement: Principles of emotional design, Creating emotionally engaging user experiences, Strategies for enhancing user engagement and retention, Case studies of emotionally successful UI/UX designs

UNIT - V

Responsive and Mobile Design: Principles of responsive web design, Mobile-first design approach, Adapting layouts and content for different screen sizes, Testing and debugging responsive designs

Designing for Mobile Platforms: Mobile UI design patterns and conventions, Navigation and interaction patterns for mobile apps, Challenges and best practices for designing mobile interfaces, Introduction to mobile prototyping tools (InVision, Marvel)

Text Books:

1. Krug, S. (2006) Don't Make Me Think, Rider publication.
2. Don Norman (2013) "The Design of Everyday Things", Published by Basic Books.

Suggested Reading:

1. Jim K. (2010) Design Basics Index, How books.
2. Lidwell, W., Holden, K. and Butler, J. (2010) Universal Principles of Design, Rockport Publishers.

Online Resources:

1. User Interface Design - Course (nptel.ac.in)
2. Introduction to User Experience Design Course (Georgia Tech) | Coursera.

22ADE29

COMPUTER VISION
(Professional Elective - I)

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

Prerequisite: Knowledge on Matrices, Linear Algebra and Calculus

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 in computer vision.
2. Apply segmentation and augmentation techniques and descriptors.
3. Identify and interpret appropriate sources of information relating to computer vision.
4. Analyse, evaluate and examine existing practical computer vision
5. Design and develop practical and innovative image processing and computer vision applications.

CO-PO Articulation Matrix:

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

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

22ADE34

INFORMATION RETRIEVAL SYSTEMS
(Professional Elective – I)

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

Prerequisite: Knowledge on Statistics and Machine Learning.

Course Objectives:
This course aims to:
1. To understand indexing and querying in information retrieval systems
2. To learn the different models for information retrieval
3. To expose the students to text classification and clustering
4. To learn about web searching

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the algorithms and techniques for information retrieval Systems
2. Learn different types of indexing, compression , scoring techniques and query processing
3. Quantitatively evaluate information retrieval systems
4. Classify and cluster documents
5. Understand the practical aspects of information retrieval such as those in web search engines

CO-PO Articulation Matrix:

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

UNIT - I
Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses. **Boolean Retrieval:** An example information, Building an inverted index, processing Boolean queries, the extended Boolean model versus ranked retrieval. **The term vocabulary and postings lists:** Document delineation and character sequence decoding, determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings, and Phrase queries. **Dictionaries and tolerant retrieval:** Search structures for dictionaries, Wildcard queries, spelling correction.

UNIT - II
Index construction: Hardware basics, blocked sort-based indexing, Single-pass in memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes. **Index compression:** Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression. **Cataloging and Indexing:** History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction. **Scoring, term weighting and the vector space model:** Parametric and zone indexes, Term frequency and weighting, the vector space model for scoring, and Variant tf-id functions

UNIT - III
Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance. **Relevance feedback and query expansion:** Relevance feedback and pseudo relevance feedback, Global methods for query reformulation. **Probabilistic information retrieval: Basic probability theory,** The Probability Ranking Principle, The Binary Independence Model. **Language models for information retrieval:** Language models, The query likelihood

UNIT - IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection. **Vector space classification:** Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbor, Linear versus nonlinear classifiers. **Flat clustering:** Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means. **Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT - V

Matrix decompositions and Latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing. **Web search basics:** Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling. **Web crawling and Indexes:** Overview, Crawling, Distributing indexes, Connectivity servers. Link analysis: The Web as a graph, Page Rank, Hubs and Authorities

Text Books:

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, An Introduction to Information Retrieval, Cambridge University Press, Cambridge, England,2008
2. David A. Grossman, OphirFrieder, Information Retrieval–Algorithms and Heuristics, Springer, 2nd Edition (Distributed by Universities Press),2004.

Suggested Reading:

1. Gerald J Kowalski, Mark T Maybury. Information Storage and Retrieval Systems, Springer,2000
2. SoumenChakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan- Kaufmann Publishers,2002.

Web Resources:

1. https://www.geeksforgeeks.org/what-is-information-retrieval/
2. https://www.upgrad.com/blog/information-retrieval-system-explained
3. https://www.udemy.com/course/python-webscraping-for-information-retrieval-and-analytics

22CEO01

INFRASTRUCTURE FOR SMART CITIES
(Open Elective-I)

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

References:

1. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science.
2. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines(1).pdf
3. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988 5. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ar12/preview
2. http://acl.digimat.in/nptel/courses/video/105105160/L01.html

22MBO05

ENGINEERING LEADERSHIP
(Open Elective-I)

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

Course Objectives:
This course aims to:
1. 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

22ECO02

REMOTE SENSING and GIS
(Open Elective-I)

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

Prerequisite: Basic knowledge of Geography is required

Course Objectives:

This course is aims to:

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

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

1. Demonstrate the understanding of basic concepts of remote sensing and interpreting energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

Course Articulation Matrix:

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

UNIT-I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages, and limitations of Remote sensing.

UNIT-II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT-III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT-IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

22MEO06

PRINCIPLES OF ENTREPRENEURSHIP AND STARTUPS
(Open Elective-I)

Instruction	3 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. Impart basic concepts and procedure of idea generation.
2. Familiarize the nature of industry and related opportunities and challenges.
3. Familiarize with elements of business plan and its procedure.
4. Learn the project management and its techniques.
5. Know the behavioral issues and time management.

Course Outcomes: Upon completion of this course, the students will be able to
1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

CO-PO Articulation Matrix

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

UNIT - I

Entrepreneurship: Definition, Characteristics of an Entrepreneur, Functions of Entrepreneurs, Entrepreneur vs. Intrapreneur, First Generation Entrepreneur, Women Entrepreneurship, Ideas and their Sources, Conception and Evaluation of Ideas.

Behavioral Aspects of Entrepreneurs: Personality: Determinants, Attributes and Models, Leadership: Concepts and Models, Values and Attitudes, Motivation Aspects.

UNIT - II

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic Growth, Small Scale Industry in India, objectives, Linkage among Small, Medium and Heavy Industries, Types of Enterprises, Corporate Social Responsibility.

UNIT - III

Business Plan: Introduction, Elements of Business Plan and its salient features, Business Model Canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility Studies, Executive Summary.

UNIT - IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management.

Time Management: Approaches of Time Management, their strengths and weaknesses. Time Management Matrix, Urgency Addiction.

UNIT - V

Startup: Definition, Startup Ecosystem, Startup Incubator, Need and Importance of Startups and Incubation Centers. Sources of Finance and Incentives for Startups. Innovation, Creativity, Intellectual Property in Entrepreneurial Journey. Business firm Registration Process in INDIA.

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw- Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5th edition, Tata Mc Graw Hill Publishing Company. Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

22CAC02

IMAGE PROCESSING LAB

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

Course Objectives: The objectives of this course are

1. To understand the fundamental concepts of Image processing.
2. To explore Discrete Fourier Transform for 1-D and 2-D signal.
3. To apply filtering techniques on 1-D and 2-D Images.
4. To apply gray scale morphological algorithms for edge image processing.

Course outcomes: On successful completion of the course learner will be able to:

1. Study the image fundamentals, mathematical transforms necessary for image processing.
2. Apply the concept of spatial filtering techniques.
3. Implement Digital Signal Transform techniques DFT.
4. Use the enhancement techniques for digital Image Processing
5. Implement the concept of gray scale morphological algorithms.
6. Develop small projects of 1-D and 2-D Digital image Processing.

CO-PO Articulation Matrix:

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

Programs List:

1. Display of Gray scale Images.
2. Histogram Equalization.
3. Design of Non-linear Filtering.
4. 2-D DFT and DCT.
5. Filtering in frequency domain.
6. Display of colour images.
7. Conversion between colour spaces.
8. DWT of images.
9. Segmentation using morphological watershed algorithm.
10. Segmentation using gray-scale morphological algorithms.

Text Books:

1. Rafael.C,Gonzalez, Richard E Woods, “Digital Image Processing”,3rdEdition, Pearson India, 2013.
2. Jain A.K, “Fundamentals of Digital Image Processing”, 4th Edition, Prentice hall of India, 2004.

Reference Books/Other Reading Material

1. B.Chanda, D. DuttaMajumder, “Digital Image Processing and Analysis”, 2ndEdition, Phi learning, 2011.
2. William K Pratt, “Digital Image Processing”, 4th Edition, Wiley, 2012.

Online Resources:

1. https://www.youtube.com/watch?v=DSGHkvQBMbs&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7En-WGX8
2. https://archive.nptel.ac.in/courses/117/105/117105135/

22AMC11

OPTIMIZATION TECHNIQUES FOR MACHINE LEARNING LAB

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

Course Objectives: The objectives of this course are

1. To Understanding optimization techniques.
2. To understand the various hyperparameter optimization techniques.
3. To understand the different variants of gradient descent algorithms with Classification and regression.
4. Application of Optimization Techniques in Neural Networks using real world datasets.

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

1. Understanding Optimization Techniques.
2. Implement the Hyperparameter Tuning in Machine Learning.
3. Illustrate Hyperparameter Optimization Using Real-world Data.
4. Explore Gradient Descent Variants and Optimization.
5. Optimization Techniques in Neural Networks.

CO-PO Articulation Matrix:

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

List of Experiments:

1. Explore the Libraries
   Optimization : Scikit-Optimize (skopt), Optuna, Hyperopt
   Visualization : Matplotlib ,Seaborn, Plotly, Altair,TensorBoard, Yellowbrick and MLflow.
2. Implement hyperparameter tuning for different machine learning algorithms including Random Forest, Boosting Algorithms (e.g., XGBoost, LightGBM), and Neural Networks.
3. Implement the Hyper-parameter optimization techniques using any .csv dataset.
4. Implement the different Gradient Descent with Batch Gradient Descent using .csv dataset (for regression) or the image dataset (for classification).
5. Implement the different Gradient Descent with Stochastic Gradient Descent (SGD) and Mini-batch Gradient Descent using any .csv dataset (for regression) or image dataset (for classification).
6. Implement the Momentum-Based Optimization using image dataset.
7. Implement the Adagrad, RMSprop, and Adam using Neural Network and visualize.
8. Implement the genetic algorithms and simulated annealing to optimize hyperparameters of a machine learning model.
9. Implement Feature Selection Using Genetic Algorithms for Optimizing with Machine learning algorithm and Machine Performance on the Medical Image Dataset.
10. Implement Feature Selection Using Stochastic Optimization for Optimizing Neural Network and Machine Performance on the Image Dataset.

Text Books / Suggested Reading:

1. Mykel J. Kochenderfer and Tim A. Wheeler, Algorithms for Optimization, MITPress,2019
2. Optimization for Machine Learning (Jason Brownlee), Machine Learning Mastery.
3. Linear Algebra and Learning from Data, Gilbert Strang.
4. Optimisation for Machine Learning by Suvrit Sra, MIT Press.

Resources:

1. https://github.com/harsh306/awesome-nn-optimization
2. https://github.com/Kulbear/deep-learning-coursera/tree/master/Improving%20Deep%20Neural%20Networks%20Hyperparameter%20tuning%2C%20Regularization%20and%20Optimization.

Online Resources:

1. Optimisation for Machine Learning: Theory and Implementation: https://onlinecourses.nptel.ac.in/noc23_cs64/preview

22CAC05

DEEP LEARNING LAB

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

Pre-requisites: Artificial Intelligence, Machine Learning.

Course Objectives: The objectives of this course are

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: On Successful completion of the course, students will be able to

1. Evaluate the performance various optimization techniques used in deep learning.
2. Analyze various Autoencoders 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
CO1	3	3	2	2	3	1	1	1	1	1	1	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2
CO3	3	3	3	3	3	1	1	1	1	1	1	2
CO4	3	3	3	3	3	1	1	1	2	2	2	3
CO5	3	3	3	3	3	1	1	1	2	2	2	3

List of Experiments:

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

Textbooks:

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.

Online 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/

22CSC17

DESIGN AND ANALYSIS OF ALGORITHMS LAB

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

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. Enhance programming skills while improving their practical knowledge in implementing the algorithms.
3. 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
CO1	2	-	-	1	1	-	-	-	-	-	-	-
CO2	2	2	1	2	1	-	-	-	-	-	-	-
CO3	2	3	1	1	3	-	-	-	-	-	-	-
CO4	2	2	1	1	3	-	-	-	-	-	-	-
CO5	2	2	1	-	2	-	-	-	-	-	-	-

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", MIT Press/McGraw-Hill, 4rd Edition, 2022.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis, and Internet Examples", Second Edition, Wiley, 2001.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2024-25

B.E.-Artificial Intelligence &Machine Learning

SEMESTER – VI

S. No	Course Code	Category	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
				Hours per Week			Durationof SEE in Hours	Maximum Marks		
				L	T	P/D		CIE	SEE	
THEORY										
1	**22CAC06**	**PCC**	Data Communication and Computer Networks	3	1	-	3	40	60	4
2	**22CAC07**	**PCC**	Automata and Compiler Design	3	1	-	3	40	60	4
3	**22**E****	**PEC**	Professional Elective – II	3	-	-	3	40	60	3
4	**22**E****	**PEC**	Professional Elective – III	3	-	-	3	40	60	3
5	**22MTC18**	**BS**	Quantum Computing for Machine Learning	3	-	-	3	40	60	3
6	**22EEM01**	**HS**	Universal Human Values – II: Understanding Harmony	-	1	-	-	50	-	1
PRACTICAL										
9	**22**E****	**PEC**	Professional Elective – II Lab	-	-	2	3	50	50	1
10	**22EGC03**	**BS**	Employability Skills	-	-	2	3	50	50	1
11	**22AMC12**	**PCC**	Mini Project	-	-	4	3	50	-	2
12	**22AMU02**		Upskill Certification Course- II	-	-	-	-	-	-	0.5
TOTAL				**15**	**3**	**8**	**-**	**400**	**400**	**22.5**

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

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

	PE2(T & L) Semester-VI		**PE3(T) Semester-VI**
22CAE03(T) & 22CAE04(L)	Data and Visual Analytics using AI	**22CAE06**	Nature Inspired Computing
22CAE08(T)& 22CAE09(L)	Reinforcement Learning	**22CAE07**	Computational Neuroscience
22CIE51(T) & 22CIE52(L)	Industrial Internet of Things Systems	**22CIE07**	Ethical Hacking
22ITE18(T) & 22ITE19(L)	Enterprise Application Development	**22ITE07**	Cloud Computing

22CAC06

DATA COMMUNICATION AND COMPUTER NETWORKS

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

Pre-requisites: Programming for problem solving, basic knowledge of logic circuits and application in digital system.

Course Objectives: The objectives of this course are,
1. To understand the principles of data communication and organization of computer networks,
2. To analyze various routing protocols and congestion control algorithms.
3. To study the functions of the transport layer and to understand application layer protocols.

Course Outcomes: On Successful completion of this course, student will be able to,
1. Learn the communication protocol suites like ISO-OSI and TCP/IP.
2. Illustrate and explain Data Communications System and its components.
3. Identify and analyses various congestion control algorithms.
4. Distinguish the internet protocols like IP, ARP, ICMP, IGMP, routing protocols and DHCP.
5. Understand the transport and application layer protocols like TCP, UDP, RTCP, HTTP, DNS and FTP

CO-PO Articulation Matrix:

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

UNIT - I
Introduction: Data communication, network types and models, TCP/IP and OSI Protocol Suite, transmission impairment, transmission modes, Transmission media (wired and wireless) and switching.

UNIT - II
Data Link Layer: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, HDLC, multiple access protocols.
LAN: Wired LAN, wireless LAN, connecting devices and Virtual LAN.

UNIT - III
Network Layer: Network layer design issues, routing algorithms, congestion control algorithms, Quality of service, IPV4, IPV6, network layer protocols: ARP, RARP, ICMP, IGMP and DHCP.

UNIT - IV
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), quality of service.

UNIT - V
Application Layer: DNS, DDNS, SMTP, POP, IMAP, SSH, SFTP, WWW, HTTP, SNMP, Firewalls.

Text Books:

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw Hill, Fifth Edition, 2017.
2. S. Tanenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2013.
3. William Stallings, “Data and Computer Communication”, Eighth Edition, Pearson Education, 2007.

Suggested Reading:

1. Larry L.Peterson, Peter S. Davie, “Computer Networks”, Elsevier, Fifth Edition, 2012.
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top–Down Approach Featuring the Internet”, Pearson Education, 2005.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105081/
2. https://nptel.ac.in/courses/106/106/106106091/

22CAC07

AUTOMATA AND COMPILER DESIGN

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

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
CO1	3	3	3	-	-	-	-	-	2	-	1	-
CO2	3	-	-	3	3	-	2	-	-	-	-	-
CO3	-	3	3	-	-	2	-	3	-	-	-	-
CO4	-	-	3	3	-	2	-	-	-	1	-	-
CO5	-	-	3	3	-	-	-	-	-	1	1	-

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

22CAE03

DATA AND VISUAL ANALYTICS USING AI
(Professional Elective - II)

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

Pre-requisites: Fundamentals of Data Science, Mathematical Foundation for Data Science & Security.

Course Objectives: The objectives of this course are

1. To understand techniques and algorithms for creating effective visualizations based on principles from graphic design.
2. To learn visual and computation techniques and tools, for typical data types
3. To learn how to complement each kind of methods and gain a breadth of knowledge
4. To create a compelling and interactive visualization of various real datasets and problems.

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

1. Understand the key techniques and theory used in visualization, including data models, graphical perception.
2. Analyze techniques for visual encoding and interaction.
3. Apply knowledge to a number of common data domains and corresponding analysis tasks, including multi-variate data, networks, text, and cartography.
4. Describe big data and use cases from selected business domains.
5. Create a dashboard for real time data

CO-PO Articulation Matrix:

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

UNIT - I:

Introduction: Data for Graphics, Design principles, Value for visualization, Categorical, timeseries, and statistical data graphics, Introduction to Visualization Tools.

UNIT - II:

Graphics Pipeline and Aesthetics and Perception: Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space.

UNIT – III:

Visualization Design : Visual Display of Quantitative Information, Data-Ink Maximization, Graphical Design, Exploratory Data Analysis, Heat Map.

UNIT – IV:

Multidimensional Data and Interaction: Query, Analysis and Visualization of Multi- Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling.

UNIT – V :

Collaboration: Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data.

Text Books:

1. Data Visualization Handbook by J. Koponen, J. Hildén, CRC Press, 2019
2. Beginner‟s Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishing 2019.
3. The Visual Display of Quantitative Information by E. Tufte, Graphics Press, 2nd Edition, 2001

Suggested Reading:

1. The Book of Trees: Visualizing Branches of Knowledge by M. Lima, Princeton Architectural Press,2014
2. Handbook of Graph Drawing and Visualization by R. Tamassia, CRC Press, 2013
3. Interactive Data Visualization for the Web by S. Murray O'Reilly Press, 2nd Edition, 2017

Online Resources:

1. https://nptel.ac.in/courses/110106072
2. https://nptel.ac.in/courses/108105103

22CAE08

REINFORCEMENT LEARNING
(Professional Elective - II)

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

Prerequisites: Probability and Statistics, Machine Learning, Data Structures

Course Objectives:

1. To Understand the fundamental principles of Reinforcement Learning and MDP Process
2. To Analyze Monte Carlo Methods and Temporal-Difference learning techniques.
3. Evaluate the use of Eligibility Traces in reinforcement learning through case studies

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

1. Acquire the fundamental concepts of Reinforcement Learning.
2. Apply the concepts of Finite Markov Decision Process to solve the complex problems.
3. Analyze and evaluate the effectiveness of Monte Carlo methods and On/Off Policy methods
4. Analyze and apply Temporal Difference Learning for real world problems.
5. Evaluate eligibility traces and novel reinforcement learning solutions.

CO-PO Articulation Matrix:

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

UNIT 1:

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 2:

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 3:

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 4:

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 5:

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.

Reference Books:

1. "Bandit algorithms," First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
2. "Reinforcement Learning Algorithms: Analysis and Applications," Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.
3. Alexander Zai and Brandon Brown "Deep Reinforcement Learning in Action," First Edition, Manning Publications 2020.

Online Resources:

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

22CIE51

INDUSTRIAL INTERNET OF THINGS SYSTEMS
(Professional Elective - II)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
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/CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	-	-	-	-	1	-	-	-	1
CO2	1	1	1	1	1	-	-	1	-	-	-	1
CO3	1	1	1	1	2	-	-	1	-	-	-	1
CO4	1	-	-	-	1	-	-	1	-	-	-	1
CO5	2	2	1	1	2	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

Reference Books:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media, 2011.

Web References:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey”, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik , JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”, Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, “What‟s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”, Electronic Design (Online), Mar. 2013.

22ITE18

Enterprise Application Development

(Professional Elective-II)

Instruction	3 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
CO1	2	1	1	2	-	-	-	-	-	-	-	-
CO2	2	2	3	3	3	2	2	2	-	1	-	2
CO3	2	3	3	3	3	2	2	2	-	1	-	2
CO4	2	3	3	3	3	2	2	2	-	1	-	2
CO5	2	2	2	3	3	-	-	-	-	-	-	1

UNIT-I

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

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

UNIT-II

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

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

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

UNIT-III

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

Redux and MUI: Introduction to Redux, State, Actions, Reducers, 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/

22CAE06

NATURE INSPIRED COMPUTING

(Professional Elective III)

Instruction	3 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. To explore Knowledge on significance of intelligence.
2. To understand Genetic algorithms and applications.
3. To understand various Optimization technique models.

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

1. Understand various bio inspired models.
2. Familiar with Genetic algorithm and its applications.
3. Explore different Ant Colony Optimization algorithmic models.
4. Compare different Artificial Bee Colony Optimization algorithmic models.
5. Apply Nature inspired techniques to real time applications.

CO-PO Articulation Matrix:

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

UNIT - I:

Models of Life and Intelligence - Fundamentals of bio-inspired models and bio-inspired computing. Evolutionary models and techniques, Swarm models and its self-organization, swarm and evolutionary algorithms. Optimization problems – single and multi-objective optimisation, heuristic, meta-heuristic and hyper heuristic functions.

UNIT - II:

Genetic algorithms - Mathematical foundation, Genetic problem solving, crossover and mutation. genetic algorithms and Markov process, applications of genetic algorithms

UNIT - III:

Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimization, variations of ACO, case studies.

UNIT - IV:

Particle Swarm algorithms - particles moves, particle swarm optimization, variable length PSO, applications of PSO, case studies. Artificial Bee Colony algorithms - ABC basics, ABC in optimization, multi-dimensional bee colony algorithms, applications of bee algorithms, case studies.

UNIT - V:

Selected nature inspired techniques-Hill climbing, simulated annealing, Gaussian adaptation, Cuckoo search, Firey algorithm, SDA algorithm, bat algorithm, case studies. Other nature inspired techniques- Social spider algorithm, Cultural algorithms, Harmony search algorithm, Intelligent water drops algorithm, Artificial immune system, Flower pollination algorithm, case studies.

Text Books:

1. Albert Y.Zomaya - "Handbook of Nature-Inspired and Innovative Computing", Springer,2006

2. Floreano, D. and C. Mattiussi-"Bio-Inspired Artificial Intelligence: Theories, methods, and Technologies" IT Press,2008

References:

1. Leandro Nunesde Castro-"Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group,2007

2. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India, New Delhi, 2005

3. Vinod Chandra S S, Anand H S - "Machine Learning: A Practitioner's Approach", Prentice Hall of India, New Delhi,2020

22CAE07

COMPUTATIONAL NEUROSCIENCE
(Professional Elective - III)

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

Course Objectives:

1. Understand the fundamental components of neuroscience, including neurons, synapses, membrane dynamics, and action potentials.
2. Gain proficiency in analyzing spike trains, including encoding and decoding processes, statistical analysis, and information processing mechanisms.
3. Understand synaptic plasticity mechanisms, learning rules, and their computational models, as well as the basics of machine learning and its types.
4. Develop proficiency in understanding and implementing artificial neural networks, including McCulloch & Pitts Neuron, perceptrons, backpropagation, and associative memory models.
5. Gain proficiency in reinforcement learning algorithms and mapping brain components to neural network models.

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

1. Describe the structure and function of neurons, synapses, and the basic mechanisms of action potential generation. They will also demonstrate knowledge of the brain's components and their roles in the central nervous system.
2. Develop skills in encoding and decoding spike trains, analyzing spike train statistics, and understanding information processing mechanisms in neural systems.
3. Explain short-term and long-term synaptic plasticity mechanisms, different learning rules, and their computational models. They will also demonstrate knowledge of basic concepts in machine learning, including supervised, unsupervised, and reinforcement learning.
4. Describe the structure and function of artificial neural networks, implement basic neural network models, and understand their applications in associative memory and pattern recognition tasks.
5. Demonstrate knowledge of reinforcement learning algorithms, including value and policy iteration, and their applications. They will also be able to map brain components, such as the cerebellum and hippocampus, to neural network models, understanding their computational principles and applications in learning and memory tasks.

CO-PO Articulation Matrix:

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

Unit -I:

Introduction to Neuroscience: Neuron, synapses, Membrane, action potential or spikes. Brain and its components- central nervous system, cerebellum, hippocampus, basal ganglia.

Neuronal Models: Hodgkin-Huxley model. Integrate-and-fire and Leaky Integrate-and-fire models.

Unit -II:

Spike trains: encoding and decoding, random processes, first passage time, spike train statistics, spike triggered average (encoding), reconstruction of stimuli (decoding), measuring spike train distances, information processing.

Unit -III:

Synaptic plasticity, synaptic strength, short term and long-term plasticity, different learning rules, modelling synaptic plasticity, learning and memory-I & II. Introduction to machine learning and types of learning-supervised, unsupervised and reinforcement learning.

Unit -IV:
Artificial neural networks- McCulloch & Pitts Neuron, Single and multi-layer perceptron, backpropagation algorithm, associative memory, auto associative neural network, Hopfield neural network, spiking neural networks.

Unit -V:
Reinforcement learning- reward function, value and policy iteration, Q-learning. Mapping brain components to neural networks- cerebellum as associative-spiking neural network, hippocampus activity measured as generative learning(autoencoder), modelling basal ganglia as a neural network.

Text Books / Suggested Reading:

1. Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems, Dayan and Abbott.
2. Patricia S. Churchland and Terrence J. Sejnowski, 1992, The computational Brain, MIT Press.
3. Concha Bielza and Pedro Larranaga, 2021, Data driven computational neuroscience: machine learning & statistical learning, Cambridge University Press.

Online Resources:

1. NOC:Computational Neuroscience, IIT Kharagpur
   https://nptel.ac.in/courses/102105100
2. Introduction to computational neuroscience, IIT Madras
   https://nptel.ac.in/courses/102106023

22CIE07

ETHICAL HACKING
(Professional Elective - III)

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

Pre-Requisites
Basic understanding of computer networks and operating systems, familiarity with programming languages like Python or C/C++, and knowledge of cybersecurity fundamentals.

Course Objectives:

1. Understand the principles and methodologies of ethical hacking.
2. Learn various techniques for reconnaissance, scanning, and enumeration.
3. Gain proficiency in vulnerability assessment and penetration testing.
4. Develop skills to identify and exploit common security vulnerabilities.
5. Acquire knowledge of ethical and legal considerations in penetration testing.

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

1. Understand the ethical and legal implications of hacking activities.
2. Demonstrate proficiency in conducting reconnaissance and scanning.
3. Identify and exploit vulnerabilities in networks and systems.
4. Perform penetration tests to assess the security posture of an organization.
5. Adhere to ethical standards and guidelines while conducting penetration testing.

CO-PO Articulation Matrix

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

Unit – I
Overview of Ethical Hacking: Definition, scope, and Importance of ethical hacking, Different types of hackers, Evolution of ethical hacking, Legal and regulatory frameworks related to hacking, Computer Fraud and Abuse Act, Code of ethics for ethical hackers, Ethical considerations in penetration testing, Hacking methodologies, Understanding the stages of ethical hacking, Tools and techniques.

Unit – II
The Digital Investigation Process- Role of Computers in Crime, Evidence in the Courtroom, Duty of Experts, Information Gathering Techniques -Search engine footprinting, Social media footprinting**,** Various tools used for footprinting, Understanding social engineering concepts, Types of social engineering attacks, phishing, pretexting, baiting, tailgating, Countermeasures and prevention techniques.

Unit – III
Introduction to port scanning-Types of port scans: TCP, UDP, SYN, ACK, FIN, NULL, XMAS -Using tools for port scanning, Enumerating services and protocols, Banner grabbing techniques, NetBIOS and SNMP enumeration, Using tools like Nessus, OpenVAS, and Nexpose-Interpreting scan results and prioritizing vulnerabilities.

Unit – IV
Types of password attacks, Password cracking tools and utilities, Password policy enforcement and best practices**,** Understanding privilege escalation, Local privilege escalation techniques, exploiting misconfigurations and vulnerabilities for privilege escalation, Introduction to rootkits and malware, Detection and removal of rootkits and malware, Rootkit and malware prevention techniques.

Unit – V

Packet sniffing techniques, ARP spoofing and DNS spoofing, Man-in-the-middle attacks, Common web application vulnerabilities: SQL injection, XSS, CSRF, Tools for identifying web vulnerabilities, Exploitation techniques, and payloads. Understanding SQL injection attacks, SQL injection vulnerabilities-Types of XSS attacks: reflected, stored, DOM-based-XSS prevention and mitigation techniques.

Text Books:

1. "The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy" by Patrick Engebretson, Second Edition, Syngress publications, 2013.
2. "CEH Certified Ethical Hacker All-in-One Exam Guide" by Matt Walker, Fourth Edition, McGraw Hill, 2019.
3. Rafay Baloch "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.

Reference Books:

1. "Penetration Testing: A Hands-On Introduction to Hacking" by Georgia Weidman, No Starch Press, US, 2014.
2. "Hacking: The Art of Exploitation" by Jon Erickson, Second Edition, No Starch Press, US, 2008.

Web References:

1. OWASP (Open Web Application Security Project): https://owasp.org/
2. SANS Institute: https://www.sans.org/
3. Offensive Security: https://www.offensive-security.com/

22ITE07

CLOUD COMPUTING
(Professional Elective- III)

Instruction	3 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, including automated scaling, load balancing, SLA monitoring, and resource management, 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, including encryption, authentication, intrusion detection, and data loss prevention, to ensure the confidentiality, integrity, and availability of cloud resources and data.
5. Evaluate different cloud computing architectures, such as workload distribution, elastic resource capacity, multi-cloud, and specialized architectures like edge computing and fog computing, 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:

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

UNIT - I

Fundamental Concepts of Cloud Computing: Goals and Benefits, Risks and Challenges, Cloud Computing Service and Deployment Models.

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.

22MTC18

QUANTUM COMPUTING FOR MACHINE LEARNING

Instruction	3 Hours per week
Duration of SEE	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 Quantum Machine Learning Concepts and Application.

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. Solve machine learning problems using Quantum computations.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	-	-	-	-	-	2	2	-
CO5	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 QuantumComputing, 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 and Quantum Phase estimation. Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm and Deutsch-Jozsa Algorithm.

UNIT-V: Quantum Machine Learning:
Quantum Un-Supervised Learning Algorithm: K-means algorithm, Quantum K- means, Quantum Supervised Learning Algorithm: Quantum HLL algorithm, Quantum Linear Regression, Quantum Support Vector Machine.

Text Books:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press.
2. David McMahon, “Quantum Computing Explained”, Wiley.
3. Quantum Machine Learning: An Applied Approach: The Theory and Application of Quantum Machine Learning in Science and Industry by Santanu Ganguly, Apress.

Reference Books:

1. Quantum Machine Learning: What Quantum Computing Means to Data Mining by Peter Wittek, Academic Press.

22EEM01

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

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

Instruction	1 Hour per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1

Introduction:
This course discusses the role of human values in one's family, in society and in nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives: This course aims to

1. Understand the concept of universal human values
2. Cultivate empathy and respect for diversity
3. Inspire the social responsibility and global citizenship

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

1. Become familiar about themselves, and their surroundings (family, society, nature).
2. Develop empathy and respect for diversity by gaining an appreciation for different cultures, perspectives, and identities
3. Exhibit responsible and ethical 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.

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	-	-	-	-

1 - Slightly, 2 - Moderately, 3 - Substantially

MODULE -1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and
- Experiential Validation- as the process for self-exploration.
- Natural acceptance of human values.
- Definitiveness of Ethical Human Conduct.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario.
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE- 2: Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE-3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
- Understanding the meaning of Trust; Difference between intention and competence.
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
- Understanding the harmony in society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals.
- Strategy for transition from the present state to Universal Human Order:
  a. At the level of individual: as socially and ecologically responsible engineers, technologists, and managers.
  b. At the level of society: as mutually enriching institutions and organizations.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.

MODULE -4: Understanding Harmony in Nature and Existence - Whole existence as Coexistence.

- Understanding the harmony in Nature.
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation in nature.
- Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
- Holistic perception of harmony at all levels of existence.
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability Identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability Identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

MODE OF CONDUCT (L-T-P-C 0-1-0-0)

- While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection, and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentors, in a group sitting.

- **Tutorials (experiments or practical) are important for this course**. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to the development of commitment, namely behaving and working based on basic human values.
- **It is advised to share the experience of the Faculty to the class in a capsule form.**
- **Involve more in evaluating the student by different activities with proper RUBRCCS**

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

EXAMPLE:

Module-1:	10 M
Module -2:	10 M
Module- 3:	10 M
Module-4:	10 M
Attendance & Attitude:	10 M

The overall pass percentage is 50%. In case the student fails, he/she must repeat the course.

Text Books:

1. "A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.
2. "Teacher's Manual for A Foundation Course in Human Values and Professional Ethics" by R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2022.

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi

22CAE04

DATA AND VISUAL ANALYTICS USING AI LAB
(Professional Elective - II Lab)

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

Pre-requisites: Fundamentals of Data Science.

Course Objectives: The objectives of this course are

1. Learn **visual** and **computation** techniques and tools, for typical data types.
2. Work on **real datasets and problems**.
3. Learn **practical** know-how (useful for jobs, research) through significant hands-on programming assignments.

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

1. Understand and describe the main concepts of data visualization.
2. Create ad-hoc reports, data visualizations, and dashboards. Creating several different charts.
3. Publish the created visualizations to Server and Public.
4. Develop interactive visualizations that couple machine learning with visual interfaces of data for exploration and sense making.
5. Understand and visualize the Time series data.

CO-PO Articulation Matrix:

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

List of Experiments:

Note: The experiment can be implement using Tableau / Google Cloud studio.

1. Introduction to Tableau, Course introduction, Getting started with Tableau Desktop, Connecting to the tutorial dataset, creating the first charts, Filtering and sorting data.
2. Creating common visualizations (bar charts, line charts etc.)
3. Assembling a dashboard layout, Using dashboard filters.
4. Transform the data: Creating simple calculations in Tableau, Using table calculations.
5. Visual Interactions: Interactivity with text and visual tooltips Interactivity with actions (filter, highlight, URL), Drilldown between dashboards.
6. Advanced visualizations: Creating more advanced chart types, using multiple source tables.
7. Data Storytelling: Intro to data storytelling, creating a data story in Tableau, Overview of the Tableau ecosystem, Further learning opportunities.
8. Distributed Stochastic Neighbor Embedding (t-SNE).
9. Online Social Networks, Social Data Analysis, Graph Visualization and Navigation.
10. Finding Patterns in Time Series Data.

Textbook:

1. Visualization Analysis & Design by Tamara Munzner CRC Press-2014 (ISBN 9781466508910)

References Books:

1. Interactive Data Visualization for the Web by Scott Murray 2nd Edition (2017)
2. The Grammar of Graphics by Leland Wilkinson
3. ggplot2 Elegant Graphics for Data Analysis by Hadley Wickham

22CAE09

REINFORCEMENT LEARNING LAB
(Professional Elective- II Lab)

Instruction	2 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 successful 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:

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

Suggestive Books:-

1. Practical Deep Reinforcement Learning with Python , Ivan Gridin, BPB Publications.
2. “Bandit algorithms,” First Edition, Lattimore, T. and C. Szepesvári. Cambridge University Press. 2020.
3. “Reinforcement Learning Algorithms: Analysis and Applications,” Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, and Jan Peters First Edition, Springer 2021.

Online Resources:-

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

22CIE52

INDUSTRIAL INTERNET OF THINGS SYSTEMS LAB
(Professional Elective - II Lab)

Instruction	2 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:

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

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

Reference Books:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Friess, “Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, Series in Communications, 2013.

Web References:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik, JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”, Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, “What‟s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”, Electronic Design (Online), Mar. 2013.
5. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
6. F. Luo et al., "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.

22ITE19

ENTERPRISE APPLICATION DEVELOPMENT LAB

(Professional Elective-II Lab)

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

Course Objectives:

1. To understand and practice HTML5 and CSS.
2. To introduce the fundamental concepts of JavaScript and Bootstrap.
3. To understand the concepts of Client-side JS Framework.
4. To work with the concepts of Server-side JS Framework.
5. To be familiar with real time database.

Course Outcomes:

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

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

CO-PO Articulation Matrix:

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

LIST OF EXPERIMENTS

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

Text Books:

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

Suggested Reading:

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

Web Resources:

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

22EGC03

EMPLOYABILITY SKILLS

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

Prerequisite: Basic Knowledge of Soft skills in the professional setting.

Course Objectives: To help the students

1. Learn the art of communication, participate in group discussions and case studies with confidence and 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 Articulation Matrix:

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

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.

22AMC12

MINI PROJECT

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

Course Objectives: The aim of course is

1. To explore the literature and formulate a project proposal.
2. To enhance presentation skills and technical writing proficiency.
3. To provide solutions by using modern tools.
4. To Expose Students to Project Based Learning.
5. To effective presentation and documentation.

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

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

CO-PO ARTICULATION MATRIX

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

The Students are required to choose a topic for a mini project related to the courses of the current semester or previous semester. The student 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	20
2.	PPT Preparation	5
3.	Presentation	10
4.	Question and Answers	5
5.	Report Preparation	10

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2025-26

B.E.-Artificial Intelligence &Machine Learning

SEMESTER – VII

S. No	Course Code	Category	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	22CAC08	PCC	Natural Language Processing	3	-	-	3	40	60	3
2	22**E**	PEC	Professional Elective-IV	3	-	-	3	40	60	3
3	22**O**	OE	Open Elective-II	3	-	-	3	40	60	3
4	22EGM01	AU	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	Non Credit
PRACTICAL										
5	22CAC09	PCC	Natural Language Processing Lab	-	-	2	3	50	50	1
6	22**E**	PEC	Professional Elective-IV Lab	-	-	2	3	50	50	1
7	22AMC13		Technical Seminar	-	-	2	-	50	-	1
8	22AMC14		Project Part - I	-	-	4	-	50	-	2
TOTAL				**11**	**0**	**10**	**-**	**320**	**330**	**14**

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

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

PE4(T&L) Semester-VII		Open Elective – II (Semester – VII)	
22CAE05(T) & 22CAE24(L)	Cognitive Computing	22EEO01	Energy Management System
22ADE14(T) & 22ADE15(L)	Generative AI	22EGO02	Gender Sensitization
22ITE11(T)& 22ITE12(L)	Devops Tools	22MEO03	Organizational Behaviour
22ITE13(T) & 22ITE14(L)	Unmanned Aerial Vehicles	22CHO04	Environmental and Sustainable Development

22CAC08

NATURAL LANGUAGE PROCESSING

Instruction	3 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
CO1	2	2	2	2	2	2	2	2	2	2	2	3
CO2	2	2	3	2	2	2	2	2	2	3	2	3
CO3	2	2	3	2	2	2	2	2	2	3	2	3
CO4	2	3	2	2	2	2	2	2	2	2	2	3
CO5	2	2	3	2	2	2	2	2	2	3	2	3

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.

Online Resources:

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

22CAE05

COGNITIVE COMPUTING
(Professional Elective- IV)

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

Prerequisites: Artificial Intelligence

Course Objectives:

1. To understand the basics of Cognitive Computing.
2. To provide an understanding of the central challenges in realizing aspects of human cognition.
3. To provide a basic exposition to the goals and methods of cognition in relation with Natural Language processing and Big data Analytics.
4. To analyze and understand the Cognitive techniques to build applications.

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

1. Understand what cognitive computing is, and how it differs from traditional approaches.
2. Interpret the use of Cognitive Computing in applying Natural language processing for business applications.
3. Analyze the association between Big data and Cognitive Computing.
4. Develop the business implications of cognitive computing.
5. Familiarize Advanced Analytics to Cognitive Computing for building Open source tools.
6. Apply cognitive techniques to develop applications.

CO-PO Articulation Matrix:

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

UNIT - I

Foundation of Cognitive Computing: Cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition.

Design Principles for Cognitive Systems: Components of a cognitive system, Cognitive architectures, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services.

UNIT - II

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems.

Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT- III

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data.

Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, Using advanced analytics to create value, Impact of open source tools on advanced analytics.

UNIT - IV

The Business Implications of Cognitive Computing: Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future , answering business questions in new ways , building business specific solutions , making cognitive computing a reality , cognitive application changing the market.

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing

UNIT - V

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the health care eco system, starting with a cognitive application for healthcare, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record using cognitive application to improve clinical teaching.

Text Books:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles , "Cognitive computing and Big Data Analytics" , Wiley

Reference Books:

1. Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics) Hardcover – Import, 9 September 2016 by Vijay V Raghavan (Author), Venkat N. Gudivada (Author), Venu Govindaraju (Author), C.R. Rao Professor (Author).

Online Resources:

1. http://ccn.psych.purdue.edu/papers/cogArch_agent-springer.pdf
2. https://www.sciencedirect.com/science/article/pii/S1877050915036595
3. https://onlinecourses.nptel.ac.in/noc22_ee122/preview

22ADE14

GENERATIVE AI
(Professional Elective - IV)

Instruction	3 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:

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

1. Understand the fundamental concepts and significance of Generative AI and the unique challenges associated with generative models.
2. Learn the structure, function, and applications of autoencoders and autoregressive models in machine learning.
3. Understand the principles, architecture, and applications of Generative Adversarial Networks for image generation and style transfer.
4. Grasp the architecture and functionality of transformers, and apply prompt engineering techniques using Hugging Face pretrained transformers and APIs.
5. Explore the advancements, capabilities, and practical applications of GPT models, including developing a GPT-3 powered question-answering application.

CO-PO Articulation Matrix:

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

22ITE13

UNMANNED AERIAL VEHICLES
(Professional Elective IV)

Instruction	3 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 (COs):
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
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	3	3	-	-	-	-	-	2	-
CO5	3	3	3	3	3	-	-	-	-	-	2	-

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.

Text Books:

1. Andey Lennon "Basics of R/C model Aircraft design" Model airplane news publication.
2. Theory, Design, and Applications of Unmanned Aerial Vehicles.

Suggested Reading:

1. Tom White. Hadoop - The Definitive Guide, 4th Edition, O'Reilly Publications, India, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman. Big Data for Dummies, John Wiley & Sons, Inc., 2013.
3. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010
4. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011.

Reference 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.

22ITE11

DEVOPS TOOLS
(Professional Elective - IV)

Instruction	3 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
CO1	1	2	1	1	2	1	-	1	2	1	2	1
CO2	1	2	1	1	2	1	-	1	2	1	2	1
CO3	1	1	1	1	2	1	-	1	2	1	3	1
CO4	1	2	1	1	2	1	-	1	2	1	3	1
CO5	1	2	1	2	3	1	-	1	2	1	3	1

UNIT-I

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-II

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-III

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-IV

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. **Tools: Docker Compose, Docker Swarm**

UNIT-V

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.

Reference Books:

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

22EEO01

ENERGY MANAGEMENT SYSTEM
(Open Elective - II)

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

Prerequisites: None

COURSE OBJECTIVES: This course aims to
1. Know the concept of Energy Management.
2. Understand the formulation of efficiency for various Engineering Systems.
3. Enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Energy Management.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Know the current Energy Scenario and importance of Energy Conservation.
2. Understand the concepts of Energy Management, Energy Auditing.
3. Interpret the Energy Management methodology, Energy security and Energy Strategy.
4. Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
5. Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems

CO-PO Articulation Matrix:

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

UNIT-I

Various forms of Energy and its Features: Electricity generation methods using different energy sources such as Solar energy, wind energy, Bio-mass energy, and Chemical energy such as fuel cells. Energy Scenario in India, Impact of Energy on economy, development, and environment sectors of national and international perspective.

UNIT-II

Energy Management-I: Defining Energy Management, need for Energy Management, Energy management techniques, importance of Energy Management, managing the Energy consumption, Energy Audit and Types, Energy Audit Instruments.

UNIT-III

Energy Management-II: understanding Energy costs, bench marking, Energy performance, matching energy use to requirement, optimizing the input, fuel & Energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, Energy Security

UNIT-IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for Engineers, Energy Efficient Technology in Mechanical engineering: Compressed Air System, Heating, ventilation and air- conditioning, Fans and blowers, Pumps and Pumping Systems**,**

Energy Efficient Technology in Electrical Engineering: Automatic Power Factor Controllers, Energy Efficient Motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, space cooling, energy efficiency of lifts and escalator, energy saving potential of each technology.

UNIT-V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Intelligent Buildings, And Various Energy Efficiency Rating Systems for Buildings, Green Buildings Energy Efficiency: management of green buildings, importance of embodied energy in selection of sustainable materials, green building design, waste reduction/recycling, rainwater harvesting, maintenance of the green buildings, green building certification, Renewable energy applications.

Energy Efficient Technology in Chemical Engineering: Green chemistry, Low carbon cements, recycling paper.

Text Books:

1. Umesh Rathore, 'Energy Management', Kataria publications, 2nd ediiton, 2014.
2. G Hariharaiyer, “Green Building Fundamentals”, Notion press.com
3. K V Shama, P Venkataseshaiah, "Energy management and conservation", I. K. International Publishing agency pvt. ltd., 2011, ISBN: 978-93-81141-29-8

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
2. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland Universityof Technology.
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

22EGO02

GENDER SENSITIZATION
(Open Elective - II)

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

Prerequisite: No specific prerequisite is required.

Course Objectives:
This course will introduce the students to:
1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Course Outcomes:
After successful completion of the course the students will be able to:
1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways in which gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

CO-PO Articulation Matrix:

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

UNIT – I
Understanding Gender:
Gender: Why Should We Study It? (Towards a World of Equals: Unit -1)
Socialization: Making Women, Making Men (Towards a World of Equals: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II
Gender and Biology:
Missing Women: Sex Selection and Its Consequences (Towards a World of Equals: Unit -4)
Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (Towards a World of Equals: Unit -10)
Two or Many? Struggles with Discrimination.

UNIT – III
Gender and Labour:
Housework: the Invisible Labour (Towards a World of Equals: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (Towards a World of Equals: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV

Issues of Violence

Sexual Harassment: Say No! (Towards a World of Equals: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading:"Chupulu".
Domestic Violence: Speaking Out (Towards a World of Equals: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:
New Forums for Justice.
Thinking about Sexual Violence (Towards a World of Equals: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT – V

Gender: Co - Existence

Just Relationships: Being Together as Equals (Towards a World of Equals: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

Text Books:

1. A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, VasudhaNagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu"Towards a World of Equals: A Bilingual Textbook on Gender"**,** Telugu Akademi, Hyderabad, 2015.

Suggested Reading:

1. Menon, Nivedita. "Seeing like a Feminist", Zubaan-Penguin Books, New Delhi, 2012.
2. Abdulali Sohaila, "I Fought For My Life…and Won", Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

22MEO03

ORGANIZATIONAL BEHAVIOUR
(Open Elective - II)

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

Prerequisite: None

Course Objectives: This course aims to
1. Define basic organizational behaviour principles and analyze how these influence behaviour in the work place.
2. Analyze the influence of perceptions and personality on individual human behaviour in the work place.
3. Discuss the theories of Motivation and Leadership.
4. Provide knowledge on different organizational structures; and concepts of culture, climate and organizational development and make the students familiarize with individual behavior.
5. Describe the interpersonal and their intrapersonal reactions within the context of the group and also demonstrate effective communication and decision making skills in small group settings.

Course Outcomes: Upon completion of this course, students will be able to
1. Understand Organizational Behavioural principles and practices.
2. Compare various organizational designs and cultures enabling organizational development.
3. Apply motivational theories and leadership styles in resolving employee‘s problems and decision making processes.
4. Understand the group dynamics, communication network, skills needed to resolve organizational conflicts.
5. Analyze the behaviour, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.

CO-PO Articulation Matrix:

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

UNIT – I

Introduction: Organizational behaviour, nature and levels of organizational behavior, individuals in organization, individual differences , personality and ability, the big 5 model of personality , organizationally relevant personality traits, the nature of perception , characteristics of the perceiver, target and situation , perceptual problems.

UNIT – II

Organization Structure: Organizational designs and structures, traditional and contemporary organizational designs, organizational culture and ethical behaviour, factors shaping organizational culture, creating an ethical culture, concepts, organizational climate, organization conflict, and organization development.

UNIT – III

Motivation and Leadership: Motivation, early and contemporary theories of motivation, leadership, early and contemporary approaches to leadership.

UNIT – IV

Group Dynamics: Groups and group development, turning groups into effective teams, managing change , process, types and challenges, communicating effectively in organizations, communication process, barriers to communication, overcoming barriers to communication, persuasive communication, communication in crisis situations.

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 Behaviour, Pearson Education Inc., 2012.
2. Jon L Pierce and Donald G. Gardner, Management and Organizational behaviour, Cengage Learning India (P) Limited, 2001.
3. Richard Pettinger, Organizational Behaviour, Routledge, 2010.

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones, Management and Organizational Behaviour, Pearson Education Inc., 2009.
2. John Schermerhorn, Jr., James G. Hunt and Richard N. Osborn, Organizational Behaviour, 10th edition, Wiley India Edition, 2009.

22CHO04

ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT
(Open Elective - II)

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

Course Objectives: This course will help the students:

1. To have an increased awareness on issues in areas of sustainability.
2. To understand the role of engineering & technology within sustainable development.
3. To know the methods, tools and incentives for sustainable product service system development.
4. To establish a clear understanding of the role and impact of various aspects of engineering decisions on environmental, societal and economic problems.
5. To communicate results related to their research on sustainable engineering.

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

1. Understand the concept of sustainable engineering and its significance in addressing contemporary environmental challenges.
2. Explore the 4R concept of solid waste management and examine various tools and methodologies to assess and mitigate the environmental impacts of engineering activities.
3. To be aware of the principles and requirements of environmental management standards and their application in promoting environmental sustainability.
4. Analyze the challenges and opportunities associated with promoting sustainable habitats such as sustainable cities, sustainable transport, sustainable sources of energy conventional and sustainable materials for green buildings.
5. Understand and evaluate the industrial processes through the principles of industrial ecology and industrial symbiosis.

CO-PO Articulation Matrix:

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

UNIT - I

Introduction of sustainability- Need and concept of Sustainable Engineering, Social-environmental and economic sustainability concepts, Sustainable development and challenges, Sustainable Development Goals, Environmental acts and protocols – Clean Development Mechanism (CDM).

UNIT - II

Economic and social factors affecting sustainability, Effects of pollution from natural sources, Solid waste-sources, impacts, 4R (Reduce, Reuse, Recycling, Recover) concept, Ozone layer depletion, Global warming, Tools used to ensure sustainability in engineering activities such as environmental management systems and environmental impact assessment studies.

UNIT - III

Global, Regional and Local environmental issues, Carbon credits and Carbon trading, Carbon foot print, Environmental management standards, ISO 14000 series, Life cycle Analysis (LCA)-scope and goal, Procedures of EIA (Environment Impact Assessment) in India.

UNIT - IV

Basic concept of sustainable habitat-Sustainable cities, Sustainable transport, Sustainable sources of energy conventional and renewable sources, Green Engineering: Green buildings, Green materials for sustainable design, Methods for increasing energy efficiencies of buildings**.**

UNIT - V

Technology and sustainable development, Sustainable urbanization, Industrialization and poverty reduction, Social and Technological change, Industrial processes-material selection, Pollution prevention, Industrial ecology, Industrial symbiosis.

Text Books:

1. Rag R. L., Introduction to Sustainable Engineering, 2nd Ed, PHI Learning Pvt Ltd, 2016.
2. Allen D. T and Shonnard D. R., Sustainability Engineering Concepts, Design and Case Studies, 1 st Ed, Prentice Hall, 2011.

Suggested Reading

1. Bradley A. S, Adebayo A. O and Maria. P., Engineering Applications in Sustainable Design and Development, 1st Ed, Cengage Learning, 2016.
2. Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams., Sustainable Engineering,1st Ed, Wiley, 2019.

22CAC09

NATURAL LANGUAGE PROCESSING LAB

Instruction	2 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
CO1	2	2	2	2	2	2	2	2	2	2	2	3
CO2	2	3	3	3	2	2	2	2	3	3	2	3
CO3	2	3	2	3	2	2	2	2	2	2	2	3
CO4	2	3	2	3	2	2	2	2	3	2	2	3
CO5	2	3	3	3	2	2	2	2	3	3	2	3

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.

Online Resources:

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

22CAE24

COGNITIVE COMPUTING LAB
(Professional Elective – IV Lab)

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

Prerequisites: Python Programming**,** Artificial Intelligence

Course Objectives:

1. To Understand the Various Visualization Python Libraries and the different hypothesis testing techniques
2. 2. To explore the goals and methods of cognition in relation with Natural Language processing and Big data Analytics.
3. To analyze and implement understand the Cognitive techniques to build applications.

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

1. Understand and apply various Visualization Python Libraries.
2. Analyze and apply different hypothesis testing techniques.
3. Design and implement various NLP techniques.
4. Analyze and explore Hadoop Environment.
5. Design and implement applications of Cognitive computing.

CO-PO Articulation Matrix:

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

List of experiments

1. Explore the following Environments/Libraries

   a) Tensorflow b) Pytorch c) Scikit-Learn

   d) Gensim e) OpenCV f) Spacy

2. Explore following Visualization Libraires for Cognitive Computing

   a) Tensorboard b)Yellowbrick c)LIME d)SHAP

   e)ELI5 f)InterpretML

3. To implement hypothesis testing with t-test, ANOVA, Chisquare Test
4. Implement Semantic Web with different NLP Techniques.
5. Implement Pre Processing techniques using any text data.
6. Setup Hadoop using CENT OS.
7. Data transfer from Local to Hadoop and vice versa.
8. Implement word count program with any text data using Mapreduce.
9. Implement NLP Techniques Question and Anwer using text data(Regular Environment and Hadoop Environment).
10. Implement Cognitive visual Question and Answer with health data records.

Text Books:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles , "Cognitive computing and Big Data Analytics" , Wiley

Reference Books:

1. Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics) Hardcover – Import, 9 September 2016 by Vijay V Raghavan (Author), Venkat N. Gudivada (Author), Venu Govindaraju (Author), C.R. Rao Professor (Author).

Online Resources:

1. http://ccn.psych.purdue.edu/papers/cogArch_agent-springer.pdf
2. https://www.sciencedirect.com/science/article/pii/S1877050915036595

22ADE15

GENERATIVE AI LAB
(Professional Elective – IV Lab)

Instruction	2 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:

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

1. Gain comprehensive understanding of generative AI concepts including autoencoders, autoregressive models, GANs, and transformer models.
2. Develop proficiency in implementing various generative AI models using TensorFlow or PyTorch.
3. Learn to evaluate model performance using appropriate metrics and analyze results effectively.
4. Enhance creative problem-solving abilities by experimenting with architectures, datasets, and hyperparameters.
5. Gain insights into real-world applications of generative AI models such as image generation, style transfer, and question answering.

CO-PO Articulation Matrix:

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

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.

22ITE12

DEVOPS TOOLS LAB
(Professional Elective–IV Lab)

Instruction	2 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 articulate the deployment process using puppet.

CO-PO Articulation Matrix:

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

List of Experiments:

1. To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2. Explore the Version Control System tools for Source Code Management.
3. Install git and create a GitHub account and 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. To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
9. 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.

Reference Books:

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

22ITE14

UNMANNED AERIAL VEHICLES LAB
(Professional Elective - IV LAB)

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

Course Objectives:

1. Understand the basic components of Unmanned Arial Vehicles (Drones) and its various applications.
2. Provide hands on experience on design, fabrication and flying of UAV category aircraft.
3. Integration of drones with other hardware and software applications.

Course Outcomes (COs):

Upon completing this course, students will be able to:

1. Know the parts and functions of UAVs and drones.
2. Analyse the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts.
3. Determine the payload and its corresponding propeller's RPM to successfully fly the drone.
4. Demonstrate a drone with an automatic recovery mechanism.
5. Design a mission-controlled surveillance drone.

CO-PO Articulation Matrix:

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

Lab Experiments:

1. Assemble, integrate and demonstrate the Quad copter with all necessary parts.
2. Calibration of UAV(Quadcopter) using Ardupilot Mission planner and demonstrate the calibrated IMU parameters
3. Write a program to read Telemetry parameters using Serial Port using TTC device.
4. Write a program to read GPS coordinates on Raspberry Pi and Arduino micro controller
5. Write a program to send MAVLINK commands to Pixhawk version of Flight Controller
6. Write a program to connect Dronekit for communication and testing various commands
7. Use Mission planner for flight path panning and demonstrate the transfer of planning transects to flight controller
8. Write object avoidance program using the following sensors and test them on UGV(Robot)

a. Sonar b) LiDAR c) Camera

9. Write a Program to communicate UAV/UGV using BLE/WiFi/UHF/Cellular devices
10. Write a program to communicate IOT-UAV/UGV using text & voice commanding for Swarm

Text Books:

1. Andey Lennon "Basics of R/C model Aircraft design" Model airplane news publication.
2. Theory, Design, and Applications of Unmanned Aerial Vehicles.

Suggested Reading:

1. Tom White. Hadoop - The Definitive Guide, 4th Edition, O'Reilly Publications, India, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman. Big Data for Dummies, John Wiley & Sons, Inc., 2013.
3. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010
4. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011.

22AMC13

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.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the topic
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

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

1. Study and review research papers of new field/areas and summarize them.
2. Identify promising new directions of various cutting edge technologies in Computer Science and Engineering.
3. Impart skills to prepare detailed report describing the selected topic/area.
4. Acquire skills to write technical papers/articles for publication.
5. Effectively communicate by making an oral presentation before the evaluating committee.

Seminars are to be scheduled **from 3rd week to the last week of the semester** and any change in schedule shall be discouraged. For the award of sessional marks students are **judged by three (3) faculty members** and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

For the seminar, the student shall collect the information on a specialized topic, prepare a technical report, and submit it to the department. It shall be evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar shall be evaluated for 50 internal marks. There shall be no semester end examination for the seminar.

Note: Topic of the seminar shall preferably be 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 Presentation slides	05
4	Question and Answers	05
5	Report in prescribed format	20

22AMC14

PROJECT PART- I

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

The objective of Project Phase – I is to enable the student take up an investigative study in the broad field of Computer Science and Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. Thework shall include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/ Modelling / 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 the Department Review Committee.

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

1. Review the literature related to the problem area / selected topic.
2. Undertake problem identification, formulation and solution.
3. Prepare synopsis of the selected topic.
4. Gather the required data and Set up the environment for the implementation.
5. Conduct preliminary analysis/modelling/simulation experiment.
6. Communicate the work effectively in both oral and written forms.

Guidelines for awarding CIE (Max. Marks: 50)		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	15	Project Status / Review
Publication	10	In conference/ Journal
Department Review Committee (DRC)	5	Relevance of the Topic
	5	Presentation Slide Preparation
	5	Presentation
	5	Question and Answers
	5	Quality of Report & Report Submission

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2025-26

B.E.-Artificial Intelligence &Machine Learning

SEMESTER – VIII

S. No	Course Code	Category	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
				Hours per Week			Duration ofSEE in Hours	Maximum Marks		
				L	T	P/D		CIE	SEE	
THEORY										
1	22**E**	PEC	Professional Elective-V	3	-	-	3	40	60	3
	22**O**	OE	Open Elective-III	3	-	-	3	40	60	3
2	22CEM01		Environmental Science	2	-	-	2	-	50	Non Credit
PRACTICAL										
3	22AMC15		Project Part – II	-	-	8	-	100	100	4
TOTAL				**8**	**-**	**8**	**-**	**180**	**270**	**10**

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

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

PE5(T) Semester-VIII		Open Elective – III (Semester - VIII)	
22CAE10	Conversational AI	22ECO01	System Automation & Control
22CAE11	Ethics and AI	22EGO01	Technical Writing Skills
22CIE53	Blockchain Technology	22EGO03	Indian Traditional Knowledge
22CIE14	Robot Process Automation	22MEO05	Research Methodologies and Intellectual Property Rights

22CAE10

CONVERSATIONAL AI
(Professional Elective - V)

Instruction	3 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 the basic knowledge of conversational systems and Natural Language for Dialog Systems.
2. Analyse the toolkits that can be used to develop dialogue systems.
3. Addresses open-domain non-task-oriented dialogue systems.
4. Analyse the latest research in neural dialogue systems.
5. Explore the challenges and areas for further development of more intelligent dialogue systems.

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

1. Understand various concepts, issues, and technologies of Conversational AI and Natural Language for Dialog Systems.
2. Understand the Speech Recognition.
3. Understand the Dialog Management and Modelling.
4. Analyse the achievements and issues of ongoing research of neural dialogue system.
5. Make use Neural Dialogue Systems to construct intelligent dialogue systems.

CO-PO Articulation Matrix:

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

Unit - I

Introduction to Conversational AI

Introduction to Conversational AI: Introduction to AI assistants and their platforms, Primary use cases for AI assistant technology. Building your first conversational AI: Building a conversational AI for Fictitious Inc, What's the user's intent, and responding to the user.

Natural Language Understanding for Dialog Systems: Spoken Language Understanding (SLU), Frame-based SLU.

Unit - II

NLU for Dialog Systems: Classification and Named Entity Recognition.

Speech Recognition: Dialogue System Components, General issues in speech processing, Core recognition and synthesis technology, working with commercial speech technology and Privacy issues in working with speech technology.

Unit - III

Introducing Dialogue Systems: Dialogue System, History, Present-day Dialogue System, Modeling conversation in dialogue systems.

Rule-Based Dialogue Systems: A typical dialogue systems architecture and Tools for developing dialogue systems and Evaluating Dialogue Systems.

Unit - IV

End-to-End Neural Dialogue Systems: Neural Network Approaches to Dialogue Modeling, A Neural Conversational Model, Introduction to the Technology of Neural Dialogue and Open-Domain Neural Dialogue Systems.

Evaluating Dialogue Systems: How to Conduct the Evaluation, Evaluating Task-Oriented Dialogue Systems, Evaluating Open-Domain Dialogue Systems

Unit - V

Case Study: Chatbots in healthcare and mental health support, Voice-enabled devices and smart home applications.

Text Books:

1. Andrew R. Freed. Conversational AI: Chatbots that work.
2. Michael McTear . Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots (Synthesis Lectures on Human Language Technologies).
3. Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft).
4. Yoav Goldberg. Neural Network Methods for Natural Language Processing.

Reference (s):

1. Xiaoquan Kong , Guan Wang . Conversational AI with Rasa by Packt.
2. Stephan Bisser . Microsoft Conversational AI Platform for Developers End-to-End Chatbot Development from Planning to Deployment.
3. Lee Boonstra . The Definitive Guide to Conversational AI with Dialogflow and Google Cloud build advanced enterprise chatbots, voice.

Online resources:

1. https://hao-cheng.github.io/ee596_spr2019/
2. https://github.com/search?q=conversational+AI+dialogue+systems&type=repositories
3. https://deeppavlov.ai/
4. https://github.com/jyguyomarch/awesome-conversational-ai

22CAE11

ETHICS AND AI
(Professional Elective - V)

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

Course Objectives:

1. Study the morality and ethics in AI
2. Learn about the Ethical initiatives in the field of artificial intelligence
3. Study about AI standards and Regulations
4. Study about social and ethical issues of Robot Ethics
5. Study about AI and Ethics- challenges and opportunities

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

1. Learn about morality and ethics in AI.
2. Acquire the knowledge of real time application ethics, issues and challenges including ethical harms and initiatives in AI.
3. Understand AI standards and Regulations like AI Agent, Safe Design of Autonomous andSemi-Autonomous Systems.
4. Comprehend the concepts of Roboethics and Morality with professional responsibilities.
5. Learn about the societal issues in AI ,focusing on National and International Strategies.

CO-PO Articulation Matrix:

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

UNIT - I

Introduction:

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT - II

Ethical Initiatives In Ai

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT - III

Ai Standards And Regulation

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT - IV

Roboethics: Social And Ethical Implication Of Robotics

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - EthicalIssues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT V

Ai And Ethics- Challenges And Opportunities

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

Text Books:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.
3. Larry A. DiMatteo, Cristina Poncibò, Michel Cannarsa "The Cambridge Handbook of Artificial Intelligence" Cambridge University Press, July 2022

References:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations,Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020
3. Michael J. Quinn. "Ethics for the Information Age" 6th edition Pearson.
4. Web links:https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
5. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/
6. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
7. https://sci-hub.mksa.top/10.1159/000492428

Online Resources:

1. Ethics in engineering practice: https://onlinecourses.nptel.ac.in/noc24_mg131/preview

22CIE53

BLOCKCHAIN TECHNOLOGY

Instruction	3 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
CO1	3	3	2	2	3	-	1	-	-	1	-	1
CO2	3	3	2	1	3	-	2	-	-	2	-	1
CO3	3	3	2	1	3	-	2	-	-	1	-	2
CO4	3	3	2	2	2	-	1	-	-	2	-	2
CO5	3	3	2	2	3	-	2	-	-	2	-	1

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, Thetransaction 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

PermissionlessBlockchainEthereum: Introducing Smart Contracts, Ethereum blockchain , The Ethereum stack,Ethereum virtual machine (EVM), Consensus mechanism in Ethereum, The Ethereum network, EthereumDevelopment, 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, Membershipservices, 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, “BlockchainEssentials - Core Concepts and Implementations”, APress Publishing, 2024

Online 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

22CIE14

ROBOTIC PROCESS AUTOMATION
(Professional Elective - V)

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

Pre-Requisites: None

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

PO/PSO CO	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	2	-	-	-	-	-	-	-	1
CO 2	3	2	1	1	1	-	-	-	-	-	-	-
CO 3	3	2	1	2	1	-	-	-	-	-	-	-
CO 4	3	2	1	1	-	-	-	-	-	-	-	-
CO 5	2	2	1	2	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-APIs- 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 eventsRe-visit 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.

Textbooks:

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.

Reference Books:

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 References:

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

22ECO01

SYSTEM AUTOMATION AND CONTROL
(Open Elective - III)

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

Prerequisite: Knowledge about physical parameters in industry is required

Course Objectives:
This course aims to:
1. Learn the concepts industrial control systems.
2. Learn how to measure the physical parameters in industry.
3. Learn the applications of Robots in industry.

Course Outcomes:
After completion of this course, students will be able to:
1. Understand the features of various automatic and process control systems.
2. Define and analyze various measuring parameters in the industry.
3. Compare performance of various controllers (P, PD, PI, and PID).
4. Illustrate the role of digital computers in automation.
5. Develop various robot structures for different applications

Course Articulation Matrix:

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

UNIT-I
Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.
Sensors: Sensor definition, Different types of Sensors:Motion, Position, Force, Level sensors, and Thermo couples.

UNIT-II
Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.
Measurement Techniques and Hardware: Typical Sensor outputs, Bridge measurements: General equation for bridge balance, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III
Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, Analog and Digital methods of Control.
Controller Hardware: Analog and Digital Controllers, Pneumatic controllers, Integral, derivative, PI,PD,PID controllers.

UNIT-IV
Digital Computers as Process Controllers: Introduction, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.

Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications. Trouble shooting System failures: Preliminary steps and other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested Reading:

1. Kuo B. C, "Automatic Control Systems", 9th edition
2. A.K Sawhney,"A course on Electrical and Electronic Measurements and Instrumentation".

22EGO01

TECHNICAL WRITING SKILLS

Instruction	3 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

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

Text Books:

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

22EGO03

INDIAN TRADITIONAL KNOWLEDGE
(Open Elective - III)

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

Prerequisite: Knowledge of Indian Culture.

Course Objectives:
This course aims to:
1. To get a knowledge in Indian Culture.
2. To know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval, and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

CO-PO Articulation Matrix:

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

22MEO05

RESEARCH METHODOLOGIES AND INTELLECTUAL PROPERTY RIGHTS

(Open Elective - III)

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

Prerequisite: None

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

Online Resources:

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://archive.nptel.ac.in/courses/107/101/107101088/

22CE M01

ENVIRONMENTAL SCIENCE

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

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

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

CO-PO Articulation Matrix

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

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 involvedin 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

22AMC15

PROJECT: PART – II

Instruction	8 Hours per week
Duration of SEE	-
SEE	100 Marks
CIE	100 Marks
Credits	4

The objective of 'Project: Part Phase - 2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership p. The assignment to normally include:

1. In depth study of the topic assigned.
2. Review and finalization of the Approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including team work.
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Department Review Committee.

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

1. Demonstrate a sound technical knowledge of their selected topic.
2. Design engineering solutions to complex problems utilizing a systematic approach.
3. Conduct investigations by using research-based knowledge and methods to provide valid conclusions.
4. Create/select/use modern tools for the modelling, prediction and understanding the limitation of complex engineering solutions.
5. Communicate with engineers and the community at large in written and oral forms.
6. Demonstrate the knowledge, skills, and attitudes of a professional engineer.

Guidelines for awarding CIE (Max. Marks: 100)		
Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Department ReviewCommittee (DRC)	10	Review 1
	15	Review 2
	25	Report Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Report Preparation
	10	Analytical/ Programming/Experimentation Skills
Publication	10	Quality of the work which may lead to • Publication Submitted/ Published • Products/ Prototypes/Working Models • IPR(Patent) Submitted/ Published • Projects showcased/ Presentations. • Prizes won/ If any like best projects. • Leading to a Start-Up

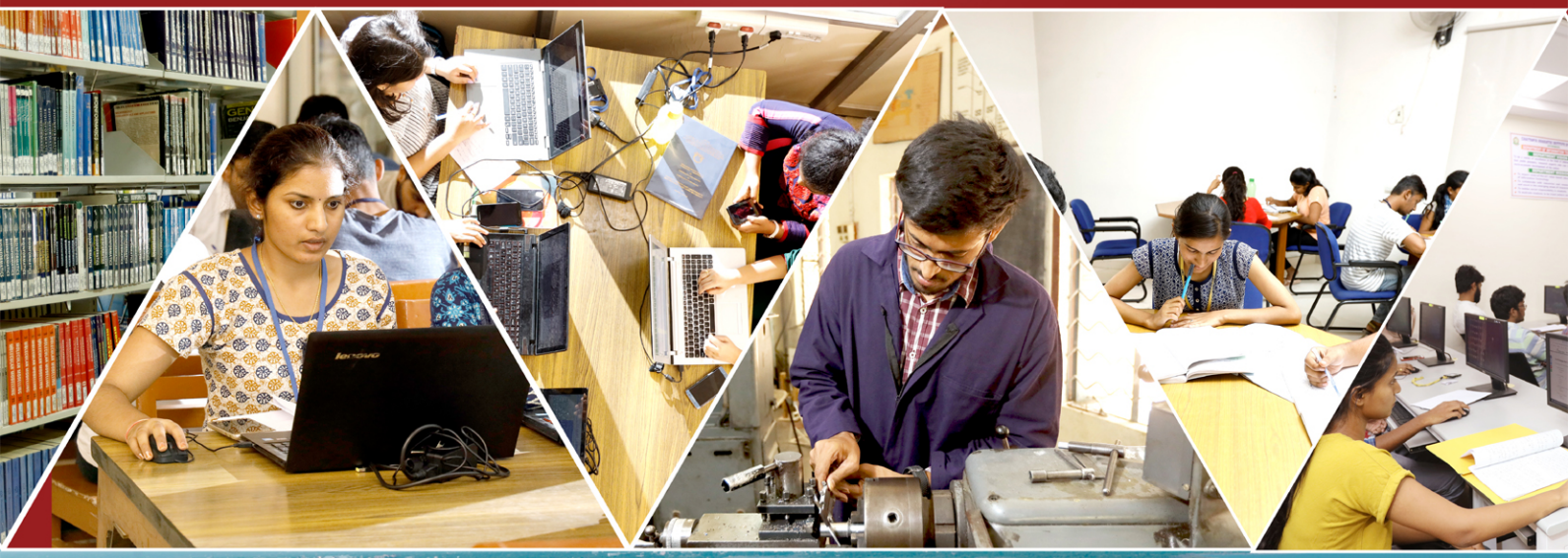
Guidelines for awarding SEE (Max. Marks: 100)		
Evaluation by	Max. Marks	Evaluation Criteria/Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the Project • Innovation • Applications • Live Research Projects • Scope for further study • Applications to Society
	20	Viva-Voce

TM

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

స్వయం తేజస్వీన్ భవ

1979



CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institute | Affiliated to Osmania University)

Accreditated by NBA & NAAC (A++)

Kokapet Village, Gandipet Mandal, Hyderabad -500075, Telanagana.

E-mail: principal@cbit.ac.in, Website: www.cbit.ac.in

Phone No. : 040-24193276 / 277 / 279