UG-R22 Curriculum
With effective from 2022-23

Artificial Intelligence and Machine Learning

Scheme of Instruction and Syllabi of
B.E I to IV 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.
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SCHEME OF INSTRUCTION AND SYLLABI

Of

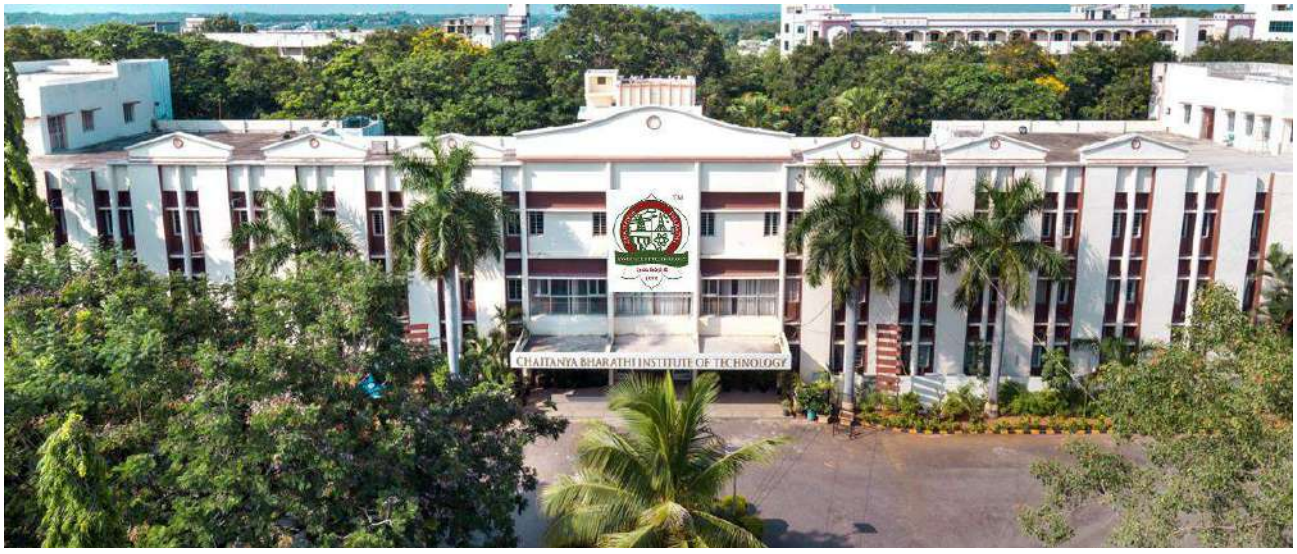
B.E. I to IV SEMESTERS

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)

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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.

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(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**

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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

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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

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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.

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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.

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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.

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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).

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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

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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

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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.

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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).

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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).

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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/

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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/

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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.

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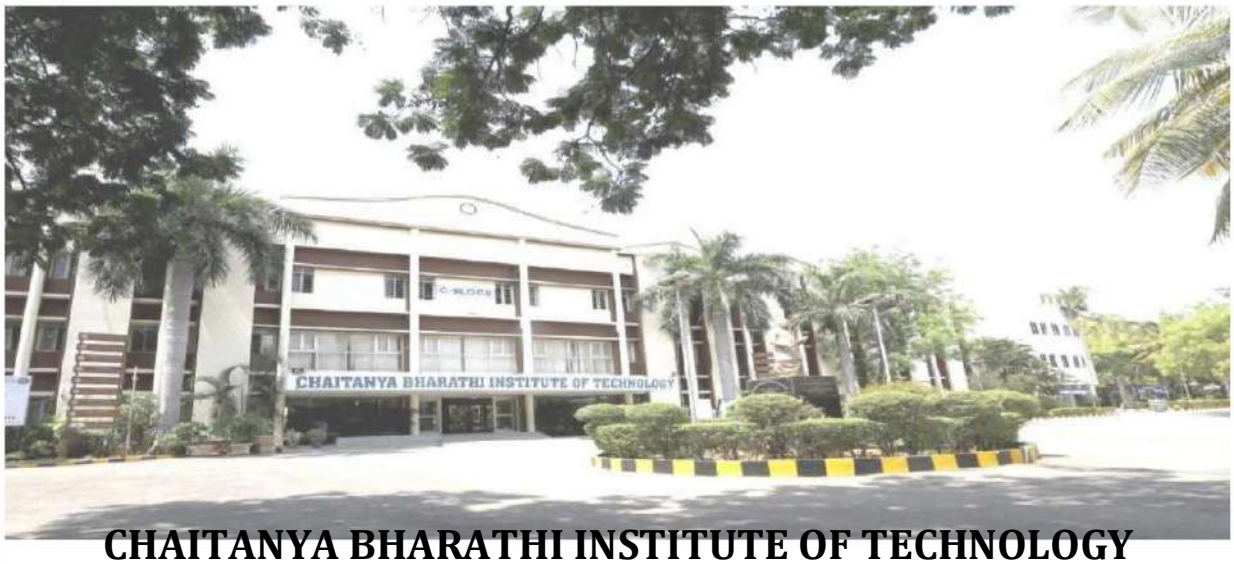
SCHEME OF INSTRUCTION AND SYLLABI (R-20)
OF
B.E. III & IV SEMESTERS
IN
ARTIFICIAL INTELLIGENCE
& MACHINE LEARNING



CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of III Semester of B.E.-Artificial Intelligence & Machine Learning as per AICTE Model Curriculum 2022-23

SEMESTER – III

S. No	CourseCode	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	20AMC01	Introduction to Algorithms & Data Structures	3	0	0	3	40	60	3
2	20AMC02	Discrete Mathematical Structures	2	1	0	3	40	60	3
3	20AMC03	Group Theory and Applications	2	1	0	3	40	60	3
4	20AMC04	Digital Logic Design	2	1	0	3	40	60	3
5	20EEC01 (R20)/ 20BTO05 R22)	Basic Electrical Engineering / Cognitive Neuroscience	2	1	0	3	40	60	3
6	20EGM03	Universal Human Values-II: Understanding Harmony	2	1	0	3	40	60	3
PRACTICAL									
7	20AMC05	Algorithms Lab-1	0	0	3	3	50	50	1.5
8	20AMC06	Introduction to Inference and Interpretation	0	1	3	3	50	50	2.5
9	20AMI01	Internship – I				3	50	50	2
TOTAL			**13**	**6**	**6**	**-**	**390**	**510**	**24**

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

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

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20AMC01

INTRODUCTION TO ALGORITHMS AND DATA STRUCTURES

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives

1. Students should be able to describe and implement various data structures including lists, arrays, stacks, queues, binary search trees, graphs, hash tables, and matrices,
2. Student should analyze and apply various algorithms for shortest path calculation, sorting and searching applications.

Course Outcomes:

1. Understand the different types of data structure to be implemented using any programming language.
2. Choose the data structures that effectively model the information in a problem and analyses the efficiency trade-offs (run time and memory usage) among alternative data structure implementations or combinations.
3. Design, implement, test, and debug programs using a variety of data structures including stacks, queues, hash tables, binary and general tree structures, search trees, and graphs.
4. Apply efficient data structure (linked lists, stacks and queues) to solve a particular problem.
5. Evaluate various searching and sorting algorithms.

UNIT I:

Introduction and Elementary Data Structures - Introduction to Data Structures and Data types, efficient use of memory, Recursion, Time and Space complexity of algorithms, Big O Notation and Theta notations. **Elementary Data Structures**: Sacks, queues, infix, postfix, & prefix conversions, evaluation of expressions, multiple stacks and queues, priority queues as heaps, double ended queue, implementation of stacks and queues.

UNIT II:

Linked Lists - Singly Linked Lists, linked stacks and queues, polynomial addition, sparse matrices, doubly linked lists and dynamic storage management, circular linked list, applications of Stacks, Queues and Linked Lists, Garbage collection, Josephus Problem.

UNIT III:

Trees -Basic terminology, binary trees, binary tree traversal, representations of binary tree, application of trees, Decision Tree, Game Tree, threaded trees, Binary Search Tree, AVL tree, B-tree

UNITIV:

Graph Theory - Graph Representations, Graph Traversals, Dijkstra's algorithm for shortest path, Prim's and Kruskal's Algorithm for Minimal Spanning Tree

UNIT - V:

Sorting and Searching - Searching: Linear search, Binary Search and Hash Search. **Sorting:** Insertion sort, Selection Sort, Bubble Sort, Quick Sort, Heap Sort, and Bucket Sort

Text Books / Suggested References:

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1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019.
2. Data Structures and Program Design in C By Robert L. Kruse,C.L. Tondo, Bruce Leung, Pearson Education, 2007.
3. Expert Data Structures with C/ 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020.
4. Expert Data Structures with C++/ 2nd Edition, R.B. Patel, Khanna Book Publishing, 2020.
5. Data Structures Using C & C++, By Langsam, Augenstein, Tanenbaum, Pearson Education, 1989.
6. Fundamentals of Data Structures, By Ellis Horowitz and Sartaj Sahni, Computer Science Press, 2011.
7. An introduction to data structures with applications, By J.P. Trembley & P.G. Sorensen, TMH, 2004.

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20AMC02

DISCRETE MATHEMATICAL STRUCTURES

(BE AI/ML)

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The main objectives of this course are to:

1. Students should be able to understand Discrete Mathematical Structures for the development of theoretical Computer Science, problem solving language using Discrete Structures
2. Understand the discrete structures towards simulation of a problem in Computer Science and Engineering.

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

1. Understand the basics of various discrete structures.
2. Write short proofs, and disprove algebraic statements by finding counter examples.
3. Apply discrete structures in the applications of Computer Science and Engineering.
4. Represent data using trees and graphs.
5. Gain skills to apply basic properties of rings and fields.
6. State the characteristics of an integral domain, and the field of quotients.

UNIT I:

Mathematical Reasoning: Mathematical reasoning, propositions, negation, disjunction and conjunction, implication and equivalence, truth tables, predicates, quantifiers, natural deduction, rules of Inference, Methods of proofs, resolution principle, applications to PROLOG.

UNIT II:

Set Theory: Paradoxes in set theory, inductive definition of sets and proof by induction, Peano postulates, Relations, properties of relations, equivalence relations and partitions, partial ordering, posets, linear and well-ordered sets

UNIT III:

Combinatorics and Functions: Elementary Combinatorics, counting techniques, recurrence relations, generating functions. Functions: mappings, injection and surjections, composition of functions, inverse functions, special functions, Pigeonhole principle, and recursive function theory.

UNIT IV:

Graph Theory: Elements of graph theory, Euler graph, Hamiltonian path, trees, spanning trees, representation of relations by graphs.

UNIT V:

Rings and Fields: Rings, Ideals, and Homomorphisms; Quotient rings; Integral domains; Finite fields; Polynomial rings, elliptic curves, Factoring polynomials; Eisenstein's irreducibility criterion.

Textbooks:

1. K. H. Rosen, Discrete Mathematics and applications, 6th Edition, Tata McGraw Hill 2007.
2. S.B. Singh, Discrete Structures/ 3rd Edition, Khanna Book Publishing, 2019.
3. S.B. Singh, Combinatorics and Graph Theory/ 3rd Edition, Khanna Book Publishing, 2018.

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4. C. L. Liu, Elements of Discrete Mathematics, 2nd Edn., Tata McGraw-Hill 2000.
5. J .L. Mott, A. Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Second edition, Prentice Hall of India 1986.
6. W. K. Grassmann and J. P. Trembnlay, Logic and Discrete Mathematics, A Computer Science Perspective, Prentice Hall Inc 1996
7. Charles C. Pinter: *A Book of Abstract Algebra*, 2nd edition.

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20AMC03

Group Theory and Applications

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Basic Algebra, transformations, computer vision/image analysis, robotics

Course Objectives: The main objectives of this course are to:

1. Introduce the importance of group theory and explore the real-world applications involving group theory.
2. Emphasize on motivations and justifications for the algorithmic usage of group theory in different domains, computational issues, and hands-on experimentation and illustration
3. Make the students to understand the representation and computation of 3D spaces using Euclidian geometry for regularity/non-regular patterns and symmetry detection

Course Outcomes: at the end of this course, student shall be able to

1. Understand the need of Group Theory and basic concepts related to Group Theory
2. Recognize the real-world applications that use group theory
3. Apply group theory for identifying symmetric and non-symmetric patterns in real-time images and structures
4. Evaluate various symmetry detection algorithms
5. Formulate solutions using group theory for real problems involving different patterns in the domains of Robotics, Computer Vision and Computer Graphics

Unit-I

Introduction to Group theory: Regularity and symmetry; **Basic concepts**: definition of a group, subgroup, different types of groups/subgroups, discrete, continuous, finite, infinitely countable, subgroup hierarchies, transform groups, matrix representations with concrete examples from robotics, computer vision (periodic pattern perception), papercut-art form, biomedical structures/images (the bio-lateral symmetry of human anatomy.

Unit-II

Representation and Computation of Groups: Example: Finding relative positions of solids in surface contact using symmetry group representation and computation for assembly planning in robotics; Representation and computation of the proper Euclidian Group and all its subgroups, geometric invariants, Hilbert's 18^{th} problem and computational model for periodic pattern perception.

UNIT-III

Symmetry Detection Algorithms: Review of symmetry detection algorithms, Computational challenges in symmetry group applications (from human and animal gaits, to the formalization of papercut-art forms), a symmetry-based grammar of forms in architecture design.

UNIT-IV

Non-symmetric structures and Statistical Computation: Global distortions and symmetry groups, local distortions and near-regular texture analysis/synthesis/manipulation/tracking, skewed symmetry groups: wallpaper groups and frieze groups; Non-regular structures: basic symmetry group concepts meet statistical computation.

UNIT-V

Group Theory Applications: Group theory in Material Science, continuous and discrete cases: Lie group, Group theory applications in medical image analysis, group theory and statistics, pattern theory.

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Text Books:

1. D. S. Dummit and R. M. Foote, Abstract Algebra, Third edition, published by John Wiley & Sons, 2004.
2. Symmetry Groups in Robotics Assembly Planning and Specifications", Yanxi Liu, the Mathematical Methods in Technology series
3. C C Pinter, "A Text Book of Abstract Algebra", 2nd Edition, Dover Books in /mathematics, 2010

References:

1. https://www.cs.cmu.edu/~yanxi/newtest.htm
2. https://mdpi-res.com/d_attachment/symmetry/symmetry-10-00263/article_deploy/symmetry-10-00263.pdf?version=1530710440
3. http://vision.cse.psu.edu/research/symComp13/index.shtml
4. http://vision.cse.psu.edu/research/performanceEvaluation/NEWeval-1.pdf
5. https://www.researchgate.net/profile/Yanxi-Liu-4/publication/248804899_A_Quantitative_Evaluation_of_Symmetry_Detection_Algorithms/links/54d54b650cf2464758075693/A-Quantitative-Evaluation-of-Symmetry-Detection-Algorithms.pdf?origin=publication_detail
6. https://paperswithcode.com/task/symmetry-detection
7. https://springerplus.springeropen.com/track/pdf/10.1186/s40064-015-1156-7.pdf

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Department of Computer Science & Engineering
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Gandipet, Hyderabad-500 075.(T.S.)

20AMC04

DIGITAL LOGIC DESIGN

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

Course Objectives: The objectives of this course are

1. To understand the basic building blocks of digital hardware and various minimization techniques.
2. To analyse and design the Combinational and Sequential circuits.
3. To design the circuits using verilog HDL.

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

1. Demonstrate the number system conversions and simplify Boolean functions.
2. Recall basic theorems and properties of Boolean algebra to represent logical functions in canonical and standard forms.
3. Analyze and simplify Boolean expressions using karnaugh-maps and tabulation method.
4. Analyze and Design various combinational circuits and Sequential circuits used in Computer Hardware.
5. Understand the designs of Combinational and Sequential circuits using Verilog HDL.
6. Develop different applications by configuring registers, counters and memories.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

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

UNIT - I

Digital Systems and Binary Numbers: Digital systems, Binary numbers, Number base conversions, Octal and Hexadecimal numbers, Complements of Numbers, Binary codes. **Boolean Algebra and logic Gates:** Binary logic, Basic Definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates, Integrated Circuits.

UNIT - II

Minimization of Switching Functions: Introduction, the map method, minimal functions and their properties, the tabulation procedure, the prime implicant chart. **NAND and NOR Gates**: NAND Circuits, Two-level Implementation, Multilevel NAND Circuits, NOR Circuits. **Exclusive OR Gates**: Odd Function, Parity Generation and Checking.

UNIT - III

Combinational Logic Design: Combinational Circuits. **Analysis Procedure:** Derivation of Boolean Functions, Derivation of the Truth Table, Logic Simulation. **Design Procedure:** Decoders, Encoders, Multiplexers - Designing Combinational Circuits using Multiplexers, Binary Adders, Adder-Subtractor, Binary Multiplier, HDL Representations – Verilog.

UNIT - IV

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Sequential Circuits: Sequential circuit definitions, Latches, Flip Flops, Sequential circuit analysis, Sequential circuit design, Design with D Flip Flops, Designing with JK Flip-Flops, HDL representation for sequential circuits - Verilog.

UNIT - V

Registers: Registers, Shift registers. **Counters**: Ripple Counters, Synchronous Binary counters, Other Counters. **Memory and Programmable Logic**: Introduction, Random-Access Memory, Memory Decoding, Error Detection and Correction, Read-Only Memory, Programmable Logic Array (PLA), Programmable Array Logic (PAL).

Text Books:

1. Morris Mano M. and Michael D. Ciletti, "Digital Design, With an Introduction to Verilog HDL", Pearson 5th edition, 2013.
2. ZVI Kohavi, "Switching and Finite Automata Theory", Tata McGraw Hill 2nd Edition, 1995.

Suggested Reading:

1. Ronald J Tocci, Neal Widmer, Greg Moss, "Digital Systems: Principles and Applications", Pearson 11th Edition, 2011.
2. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design, McGraw Hill 2nd Edition, 2009.

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CBIT(A) With effect from the academic year 2021-22

20EEC01

BASICS OF ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	03

Course Objectives: The objectives of this course are

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

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

1. Understand the concepts of Kirchhoff‟s laws and to apply them in superposition, Thevenin‟s and Norton‟s theorems to get the solution of simple dc circuits
2. Obtain the steady state response of RLC circuits with AC input and to acquire the basics, relationship between voltage and current in three phase circuits.
3. Understand the principle of operation, the emf and torque equations and classification of AC and DC machines
4. Explain various tests and speed control methods to determine the characteristic of DC and AC machines.
5. Acquire the knowledge of electrical wiring, types of wires, cables used and Electrical safety precautions to be followed in electrical installations.
6. Recognize importance of earthing, methods of earthing and various low-tension switchgear used in electrical installations

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO 1	3	3	2	3	3	-	3	-	1	2	2	3	-	1	1	1
CO 2	3	3	2	3	2	-	3	-	1	2	2	3	-	1	1	1
CO 3	3	3	2	1	3	-	2	-	1	2	2	3	-	1	1	1
CO 4	2	3	-	1	3	-	2	-	1	2	1	3	-	1	1	1
CO 5	2	-	-	1	1	2	2	1	1	1	2	3	-	1	1	1
CO 6	2	-	-	1	3	1	2	1	1	1	2	3	-	1	1	1

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first-order RL and RC circuits.

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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, RL, RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Transformers: 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, series and compound generators.

DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors. 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, 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 Mc Graw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGrawHill,2009
4. P.V. Prasad, S. sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013.

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20BTO05

COGNITIVE NEUROSCIENCE

(BE AI/ML)

Instruction	2L-1T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The main objectives of this course are to:

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

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

1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand brain's neuro-transimitter system.
3. Understanding the brain's methods gives rise to behavior whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.

UNIT I:

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

UNIT II:

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

UNIT III:

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

UNIT IV:

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

UNIT V:

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

Textbooks:

1. Principles of Cognitive Neuroscience, 2nd Edition (2013) *Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff*. Sinauer Associates, Inc.
2. Mark Bear, Brian Connors, and Michael Paradiso (2007) Neuroscience: Exploring the Brain. 3rd ed. Baltimore: Lippincott, Williams & Wilkins.

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20EGMO3

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

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

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

Introduction

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

Course Objectives

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes

By the end of the course,

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

The course has 28 lectures and 14 practice sessions:

Unit 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
- Continuous Happiness and Prosperity- A look at basic Human Aspirations

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- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario
- Method to fulfill 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.

Unit 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

Unit 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 the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

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 with scenarios. Elicit examples from students' lives

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in the Nature

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- 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
- Holistic perception of harmony at all levels of existence.

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.

Unit 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- 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 Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analysing 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 mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real

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life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.

- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

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:

Assessment by faculty mentor: 10 marks

Self-assessment/Assessment by peers: 10 M

Socially relevant project/Group Activities/Assignments: 20 marks

Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books

The Text Book

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

The teacher's manual

2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. A Nagaraj Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful"
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom -
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book)

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20AMC05

ALGORITHMS LAB-1

Instruction	0L-0T-3P
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives

1. Implement various data structures including lists, arrays, stacks, queues, binary search trees, graphs, hash tables, and matrices,
2. Analyze and apply various algorithms for shortest path calculation, sorting and searching applications.

Course Outcomes

1. Derive abstract data types for linear and non-linear data structures.
2. Implement different types of data structures using any programming language.
3. Choose and Implement the data structures that effectively model the information in a problem and analyses the efficiency trade-offs (run time and memory usage) among alternative data structure implementations or combinations.
4. Test and debug programs using a variety of data structures including stacks, queues, hash tables, binary and general tree structures, search trees, and graphs.
5. Apply efficient data structure (linked lists, stacks and queues) to solve a particular problem.
6. Evaluate various searching and sorting algorithms.

Laboratory/ Practical Experiments:

1. Implement infix to postfix conversion using Stack
2. Implement Queue using arrays
3. Write a program for swapping nodes in a linked list without swapping data.
4. Write a program to reverse a Linked List in groups of given size.
5. Write a program for finding the first circular tour that visits all petrol pumps.
6. Implement In order tree traversal without recursion.
7. Write a program to Check whether a given graph is Bipartite or not.
8. Implement Quick Sort and Heap Sort

Text Books / Suggested References:

1. Data Structures, R.S. Salaria, Khanna Book Publishing, 2019.
2. Data Structures and Program Design in C By Robert L. Kruse,C.L. Tondo, Bruce Leung, Pearson Education, 2007.
3. Expert Data Structures with C/ 3rd Edition, R.B. Patel, Khanna Book Publishing, 2020.
4. Expert Data Structures with C++/ 2nd Edition, R.B. Patel, Khanna Book Publishing, 2020.
5. Data Structures Using C & C++, By Langsam, Augenstein, Tanenbaum, Pearson Education, 1989.
6. Fundamentals of Data Structures, By Ellis Horowitz and Sartaj Sahni, Computer Science Press, 2011.
7. An introduction to data structures with applications, By J.P. Trembley & P.G. Sorensen, TMH, 2004.

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20AMC06

INTRODUCTION TO INFERENCE AND INTERPRETATION

(BE AI/ML)

Instruction	0L-1T-3P
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2.5

Course Objectives: The main objectives of this course are to:

1. Achieve competency in identifying causal effects using varied modelling approaches, starting with the essential experimental designs to complex observational models
2. Implement a variety of computational statistical tools and strategies for causal inference
3. Develop programming skills to relate different ways of explaining the data, and data collection strategies

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

1. Get awareness of causal thinking and understand selection bias.
2. Understand counterfactual vital ideas and assumptions of causal inference methods.
3. Apply causal inference methods to assess whether these assumptions are reasonable, and finally, the ways to interpret the quantity being estimated.
4. Use R to work on data science related projects.
5. Develop scripts for data visualization, analytics and dashboards.

UNIT I:

Introduction to R– Introduction to R, operators, objects, vectors, functions, data files, saving objects, packages

UNIT II:

Causality - Racial discrimination in the labour market, sub-setting data in R, causal effects and the Counterfactual, randomized controlled trials, observational studies, descriptive statistics for a single variable.

UNIT III:

Measurement & Visualization – Handling missing data, visualizing univariate distribution, survey sampling, summary of bivariate relationships, clustering.

UNIT IV:

Prediction and Discovery – Linear regression, Regression and Causation, textual data, network data, spatial data, animation using R.

UNIT V:

Probability - Conditional Probability, Random Variable and Probability Distributions, Large Sample Theorems, Estimation, Hypothesis Testing, Linear Regression Model with Uncertainty.

Textbooks:

1. Kousuke Imai, Quantitative Social Science: An Introduction, Princeton University Press, 2017.
2. Jonas Peters, Domnik Janzig and Bernhard Scholkopf, " Elements of Causal Inference – Foundations of Machine Learning", 2017, MIT, Open Access (https://mitp-content-server.mit.edu/books/content/sectbyfn?collid=books_pres_0&id=11283&fn=11283.pdf)

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20AMI01

INTERNSHIP -I

Instruction/ Duration of End Examination	4 Hours per week
Semester End Examination	50
Continuous Internal Evaluation	50
Credits	2

Course Objectives: The objectives of this course are Course Outcomes:

On Successful completion of the MooCs/Training/ Internship, students will be able to apply new technologies for real time projects.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of IV Semester of B.E.-Artificial Intelligence & Machine Learning as per AICTE Model Curriculum 2022-23

SEMESTER – IV

S. No	CourseCode	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	20AMC07	Modern Computer System Architecture	3	0	0	3	40	60	3
2	20AMC08	Database Systems	2	1	0	3	40	60	3
3	20AMC09	Linear Regression Modeling for Data Analysis	2	1	0	3	40	60	3
4	21MBC03	Strategic Entrepreneurship	2	1	0	3	40	60	3
5	20EEC38	Signal Processing	2	1	0	3	40	60	3
6	20MEC39	Robotics and Automation	2	1	0	3	40	60	3
PRACTICAL									
7	20MEC40	Robotics and Automation	0	0	3	3	50	50	1.5
8	20AMC10	Database Systems Lab	0	0	3	3	50	50	1.5
9	20AMC11	Building Large, Reliable Software Systems	0	2	2	3	50	50	3
TOTAL			**13**	**7**	**8**	**-**	**390**	**510**	**24**

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

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

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20AMC07

MODERN COMPUTER ARCHITECTURE

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are:

1. Students should be able understand basic principles of Computer Systems.
2. Students should be able to understand various logic design techniques and their applications.
3. Students should be capable of using high performance computing architecture.

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

1. Understand the organization of the Control, arithmetic, logic unit, and memory unit and the I/O.
2. Analyze different computer architectures and their applications.
3. Understand distributed computing architecture and high-performance computing.

UNIT I:

Basics - Designing combinational and sequential logic, computers registers and instructions, timing, and control, instructions cycle, memory reference instruction, I/O interruption, Adder and Subtractor circuits, Booth Multiplication algorithm, pipelining review, control hazards and the motivation for caches, cache characteristics and basic superscalar architecture basics.

UNIT II:

Multi-core Architectures - Memory Technologies, memory hierarchy, locality principle and caching, advanced optimizations, performance improvement techniques; *DRAM*– organization, access techniques, scheduling algorithms and signal systems. Tiled Chip Multi-core Processors (TCMP), Network on Chips(NoC); NoC router – architecture, design, routing algorithms and flow control techniques, compression, prefetching, QoS.

UNIT III:

Distributed Computing Systems and Concurrency - Relation to Parallel Multiprocessors/multicomputer Systems, Distributed and Concurrent Program, Message Passing vs. Shared Memory Systems, Synchronous vs. Asynchronous executions, design issues and challenges, Distributed Computing Technologies, Clocks and Synchronization, Coordination and Agreement Algorithms, Global State and Distributed Transactions.

UNIT IV:

High Performance Computing (HPC) - HPC Architecture, Parallel Processing, Parallel Memory Models, Data vs. Task Parallelism, High Throughput Computing, Vectorization, Multithreading.

UNIT V:

High Performance Computing with CUDA - CUDA programming model, basic principles of CUDA programming, concepts of threads and blocks, GPU and CPU data exchange.

Text Books and References:

1. M. Morris Mano, Computer System & Architecture, Prentice Hall of India, 2002.
2. John L. Hennessy and David A Patterson, Computer Architecture-A quantitative approach, Morgan Kaufmann/ Elsevier, 4th Edition, 2007.
3. Hayes. J.P, Computer architecture and organization by McGraw-Hill Companies, 1998
4. David Culler and J.P. Singh with Anoop Gupta, "Parallel Computer Architecture: A Hardware/Software Approach", Morgan Kaufmann, 1998.
5. https://onlinecourses.nptel.ac.in/noc20_cs41/preview
6. https://www.coursera.org/learn/introduction-high-performance-computing#syllabus

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NPTEL/SWAYAM Course:

1. Computer Architecture, Prof. Smruti Ranjan Sarangi, IIT Delhi.
2. Advanced Computer Architecture, Prof. John Jose, IIT Gowhati.

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20AMC08

Database Systems

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are:

1. Students should be able to understand various basics of DBMS and query languages
2. Student should learn different types of database systems and their applications in different scenarios

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

1. Understand the basics of databases and data management
2. Understand various theoretical and practical principles involved in the design and use of database systems with the help of a database
3. Design and implement databases for various scenarios
4. Design a database scenario for handling big data

UNIT I:

Introduction - Characteristics and fundamental characteristics of Databases, Types of Data Models and Data Modeling, Elements of Database Systems, Classification and comparison of Database Management Systems (Regular and NoSQL Page), concurrency control, Lock-based concurrency control, Time-stamping methods.

UNIT II:

Structured and Semi-structured Data Management - Structured data, relational databases, Relational model, Functional Dependencies, Normal Forms, algorithms for query optimization, semi-structured data, document-databases, semi-structured data abstraction, representation and search.

UNIT III:

Transaction Management - Transaction concept, transaction state, ACID properties, serializability, recover-ability, implementation of isolation, Testing for Serializability.

UNIT IV:

Unstructured Data Management - Unstructured text, Information Retrieval Systems, Document and Ranking.

UNIT V:

Big Data Management - Platforms for Big Data, algorithms for Map-Reduce & Hadoop, Platforms for Big Grpahs, algorithms for large Graphs.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Tata McGraw Hill, 2006
2. Elmsari and Navathe, , "Fundamentals of Database Systems", Pearson Education 2013
3. Ramakrishnan and Gehrke, "Database Management Systems", McGrawHill 2003
4. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Pearson Education, 2006
5. R.P. Mahapatra, "Database Management Systems", Khanna Book Publishing 2016.
6. J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications.
7. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia, "Learning Spark: Lightning-Fast Big Data Analysis" O'Reilly Media; 1st edition.

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8. Serge Abiteboul, Peter Buneman, Dan Suciu, “Data on the Web: From Relations to Semi structured Data and XML”, 1st Edition.
9. Christopher Manning, Prabhakar Raghavan, Hinrich Schütze, “Introduction to Information Retrieval”, book and slides available online.

NPTEL/SWAYAM Course:

1. Data Base Management System, Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur.
2. Introductioon to Database Systems, Prof. Srinivas Kumar, IIT Madras.

Laboratory/ Practicals:

1. Implementation of normal forms in databases.
2. Implementation of basic SQL commands on a database
3. Implementation of information and ranking using any language
4. Implement document retrieval and ranking using any algorithm
5. Implement Map-Reduce algorithm on any big data task

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20AMC09

LINEAR REGRESSION MODLEING FOR DATA ANALYSIS

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Basic Algebra, transformations, computer vision/image analysis, robotics

Course Objectives: The main objectives of this course are to:

1. Develop a rigorous understanding of the statistical thinking behind the fundamental techniques of statistical analysis used by data scientists
2. Apply statistical techniques to data, understand why they work and how to use the analysis results to make informed decisions
3. Learn to write and run data-science centric Python scripts to apply the statistical concepts

Course Outcomes: at the end of this course, student shall be able to

1. Obtain, clean, process, and transform data using data management techniques
2. Analyze and interpret data to derive insights
3. Apply computing algorithms, mathematical and statistical models, and optimization methods to solve underlying problems

Unit-I

Introduction to Simple Linear Regression Model: Introduction, Simple linear regression model; least squares; residuals; Normal error regression model; maximum likelihood; Convex optimization: least-squares, least-absolute deviation, least-maximal deviation; Inference in simple normal regression model; Proof of Gauss-Markov theorem; Prediction of new observations; ANOVA; F-test; General linear test; coefficient of determination.

UNIT-II

Normal correlation model; Rank correlation; model diagnostics; Goodness of fit; Remedial measures: weighted least-squares and transformations; Nonparametric estimations; regression through the origin.

UNIT-III

Linear algebra: matrix version of simple linear regression; Linear algebra review: geometry of quadratic forms, multivariate Gaussians; PCA, change of basis, Cochran's theorem, and chi-square degrees of freedom.

UNIT-III: Multiple linear regression, regression with nonlinear terms; Geometry of normal equations, joint inferences; More generalized linear tests, standardized variables, and introduction to multicollinearity; Handling quantitative vs. qualitative predictors.

UNIT-V

Model Selection: prediction error, cross-validation, BIC; Outlier detection and handling; Regularization: ridge regression, robust regression; Intro to logistic regression; More on logistic regression; classification; support vector machines.

Text Books:

1. Applied Linear Regression Models. Kutner, Nachtsheim, and Neter. McGraw-Hill, 2004

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21MBC03

STRATEGIC ENTREPRENEURSHIP

Prerequisites: Nil

Course Objectives:

1. To understand the importance of generating new ideas through Entrepreneurship and identify the skills for making informed Business Decisions.
2. To provide insights on various branding, promotion, commercialization and financial planning.
3. To help the students develop their abilities for applying various Strategic Management Concepts in solving real time problems in Business.

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

1. Use innovative skills to generate ideas for new products and services.
2. Evaluate the feasibility of ideas, and develop a strategy from commercialization.
3. Use technology to select target markets, profile target customers, define venture's mission, and create business plans.
4. Take initial steps to establish a business
5. Calculate and forecast costs, breakeven, and sales
6. Establish brand, setting prices, promoting products, and managing customer relationships.

UNIT-I:

Becoming your own Boss: Identifying possible rewards and risks of business ownership, risks vs. rewards, risk factors, reasons for business success or failure; challenges with the growth of new business success, life cycle of an entrepreneurial business and challenges at different parts of the life cycle, necessary characteristics of an entrepreneur.

UNIT - II:

Identifying the Possibilities: Skills needed to make decisions based on the limited information, essential questions, generate and develop ideas into new products and services for commercialization, steps and factors to turn an idea into revenue.

UNIT-III:

Market Analysis: determining the influencing factors on purchases, effects of branding, promotion types, benefits, promotion channels, importance of small and large marketing segments

UNIT-IV:

Business Finance: Create, analyze and interpret financial documents, purpose of budget, income statement, balance sheet, understanding and interpretation of information to make business decisions, tools, strategies, and systems to plan and monitor financial resources.

UNIT-V:

Planning your Business: basic necessary requirements to own and operate a business, differences between sole partnership, partnership and corporation; a public and private business; profit and nonprofit corporation. Concept of insurance, advertisement strategies, Business and law, Corporate Social Responsibility (CSR), actualization of business and Performance assessment.

Text Books/ Suggested Readings:

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1. Greene, C. (2004), "Entrepreneurship Ideas in Action", Thomson: South-Western
2. Kennedy B. Reed, "Strategic Management", Virginia Tech, 2020.
3. Michaele A. Hitt, R D Ireland, Michael Camp, Dianal Sexton, "Strategic Entrepreneurship – Creating a New Mindset", John Wiley & Sons., 2017
4. Philip A . Wickham, "Strategic Entrepreneurship", 4t hEdition, Pearson, 2006.
5. https://vtechworks.lib.vt.edu/bitstream/handle/10919/99282/Strategic-Management.pdf?sequence=22&isAllowed=y
6. http://www.chillicothecityschs.oh.schools.bz/userfiles/319/My%20Files/Course%20syllabi%202017-2018/PRCTC/Black/2017- 2018%20Strategic%20Entrepreneurship%20Syllabus.pdf?id=4228

20EEC38

SIGNAL PROCESSING
(BE-AI&ML IV Semester)

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

Prerequisite: Knowledge of Differential and Integral Calculus.

Course Objectives:
This course aims to:

1. Understands time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. Understands time and frequency domain analysis of discrete time signals with DTFT and Z-Transforms.
3. Understands concepts of convolution.

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

1. Represents the signals and systems and Fourier series.
2. Evaluate signal characteristics and systems using Fourier Transform.
3. Assess the characteristics of systems using Laplace Transform.
4. Assess the characteristics the DT Signal using DTF and Z-Transform.
5. Apply the Convolution and correlation for analysis of Signal**.**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PS O2	PSO 3
CO1	3	2	1	-	1	-	-	-	-	2	-	2	1	1	-
CO2	3	2	1	-	1	-	-	-	-	2	-	2	1	1	1
CO3	3	2	1	-	1	-	-	-	-	2	-	2	1	2	1
CO4	3	2	1	-	1	-	-	-	-	2	-	2	-	1	1
CO5	3	2	1	-	1	-	-	-	-	2	-	2	1	1	1

UNIT-I

Signal Representation: Representation of basic signals, classification of signals, classification of systems, Trigonometric Fourier series, Exponential Fourier series, Existence and Convergence, Symmetry conditions.

UNIT-II

Fourier Transforms: The direct and inverse Fourier transforms, Existence, properties of Fourier Transforms, Fourier Transform of singularity functions, Energy Spectral Density and basic concepts of filters.

UNIT-III

Laplace Transforms: The Bilateral and unilateral Laplace transforms. Region of convergence and its properties. Properties of Laplace transform, Inverse Laplace transform.

UNIT-IV

Z–Transform: Sampling theorem, aliasing and quantization, zero order hold circuit, interpolation and decimation, DFT, Properties of DFT, Z-Transform, FFT, Decimation in time and frequency (radix-2), S–Plane and Z–Plane correspondence, Z–Transform properties and Inverse Z–Transform.

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UNIT-V

Convolution: Continuous convolution, Graphical interpretation and its properties. Discrete convolution and its properties. Random variables and Random process, Correlation and autocorrelation.

Text Books:

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 3rd Edition, 2008.
2. Simon Haykin, "Signals and Systems", Wiley India, 5th Edition,2009.

Suggested Reading:

1. Alan V. Oppenheim, Alan S. Willsky, S.HamidNawad, "Signals and Systems", PHI 2nd Edition, 2015.
2. M. J. Robert, "Fundamentals of signals and systems", McGraw Hill, 2008.

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20MEC39 **ROBOTICS AND AUTOMATION**

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objective: The main objectives of this course are to:

1. Impart knowledge about basic mathematics related to industrial robots for their control, design, and application in robotics & automation

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

1. Perform kinematic analysis with simulation
2. Perform dynamitic analysis with simulation
3. Design control laws for a simple robot
4. Integrate mechanical and electrical hardware for a real prototype of robotic device
5. Select a robotic system for a given industrial application

Unit I:

Introduction to Robotics - Introduction, classification of robots; **Kinematics systems** – mechanisms and manipulators, degrees of freedom; Kinematic Modelling- translation and rotation representation, coordinate transformation,

Unit II:

Robot Kinematics and Dynamics: DH parameters, forward and inverse kinematics, Jacobian, Singularity and Static; Dynamic Modelling: Forward and invers dynamics, equations of motion using Euler-Lagrange formulation, Newton Euler formulation

Unit III:

Sensors, Cameras and Vision - Various sensors - Contact and proximity, position, velocity, force, tactile etc., introduction to Cameras, Camera calibration, geometry of image formation, Euclidian/Similarity/Affine/Projective transformations, Vision applications in robotics

Unit IV:

Robotic Actuation Systems - Actuators: Electric, hydraulic and pneumatic. Transmission: Gears, timing belts and bearings, parameters for selection of actuators. **Robot Control**: Basic control: open-loop, closed loop, transfer functions, control laws P, PD, PID, linear and non-linear controls

Unit V:

Control Hardware and Interfacing: Microcontroller architectures and integration with sensors, actuators, components, programming applications for industrial robot, VAL II Programming.

AI in Robotics: Applications in unmanned systems, defence, medical, industries etc., Robotics and Automation for Industry 4.0, Robotics safety and social robotics

Text Books to be followed:

1. Introduction to Robotics : J. Craig , Pearson
2. Robot Dynamics and Control, Spong & Vidyasagar, Mc Graw Hill
3. Robotics Engineering : R. Klafter, PHI
4. Robotics : Subir K Saha , Mc GrawHill
5. Industrial Robotics : M. P. Groover, Ashish Dutta , McGraw Hil

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20MEC40

ROBOTICS AND AUTOMATION LAB

(BE AI/ML)

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

Objectives:

1. Impart basic knowledge about the Mechanical, Electrical and Electronic systems of robot
2. ImpTo serve as prerequisite for the elective courses like Full Stack Robotics, Mobile Robotics, AI for Robotics, Human Robot Interaction, Deep Learning Robotics etc

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

1. Demonstrate the understanding of assembly and working of a robot
2. Analyze the robot kinematics with the help of suitable software
3. Program a robot for a specific requirement
4. Apply the computer vision to the robot for a given application
5. Apply AI Technologies to the robot

Practical Experiments:

1. Study components of an industrial robot (PUMA, KUKA, FANUC, MTAB, UR , etc) and its DH parameters.
2. Forward kinematics and validation using software (Robo Analyser/MathLab or any other free software tool).
3. Inverse kinematics of an industrial robot and validation using any open source software.
4. Industrial Robot programming using VAL II or equivalent.
5. Microcontroller lab – programming (free software /open source)
6. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system. (Free software, Matlab)
7. Control experiment using available hardware or software. (Open source or Matlab).
8. Use of open source computer vision programming tool/ MatLab, open CV)
9. Research related experiment in AI, e.g. multi agent system, unmanned systems control using ROS, etc.
10. Small group project work relevant to Industrial automation

Text Books:

1. Nagrath and Mittal, Robotics and Control, Tata McGraw-Hill, 2003.
2. Spong and Vidyasagar, Robot Dynamics and Control, John Wiley and sons, 2008.
3. Mikell P. Groover, Industrial Robotics, McGraw-Hill, 2008.

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Suggested Reading:

1. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
2. Steve LaValle, Planning Algorithms, Cambridge Univ. Press, New York, 2006

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20AMC10

DATABASE SYSTEMS LAB

Instruction	0L-0T-3P
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objective: The main objectives of this course are to:

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

Laboratory/ Practical:

1. Implementation of normal forms in databases.
2. Implementation of basic SQL commands on a database
3. Implementation of information and ranking using any language
4. Implement document retrieval and ranking using any algorithm
5. Implement Map-Reduce algorithm on any big data task

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20AMC11

BUILDING LARGE, RELIABLE SOFTWARE SYSTEM

(BE AI/ML)

Instruction	0L-2T-2P
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Course Objectives: The main objectives of this course are to:

1. Make the student to understand the underlying infrastructure and Technologies for building, maintaining reliable systems
2. Understand principles of concurrency and be able to build concurrent software

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

1. Understand the principles and strategies of infrastructure for building secure and reliable systems.
2. Identify various tools and technologies to manage infrastructure and other resources.
3. Create Git-based platforms for collaborative development and maintenance of Software Products
4. Perform various tests including infrastructure, production, fail-over, capacity, security, and compliance tests.
5. Configure infrastructure resources using configuration management tools.
6. Design systems to provide concurrency.

UNIT I:

Principles and Strategies of Infrastructure: Technical Practices, Modernization of Computer, Network and Storage, Infrastructure Management, scaling production readiness, DevOps and SRE, System Admin; Life Cycles of Physical Hardware and Cloud Services, Challenges to plan infrastructure strategy, Infrastructure Stacks, Infrastructure as Code

UNIT II:

Version Control and Local Development Environments: Fundamentals of Git, Working with Remote Git Repositories, Conflict Resolution, Fixing local Repositories, Collaboration with Version Control, Editors, Languages, Installation and Configuration of Applications.

UNIT III:

Testing and Security: Need and types of tests, shape of test strategy, main tests to plan, Flaky Tests; Security collaboration, Data Assets, attack vectors and surfaces, Design for Security Operability, Qualifying issues.

Unit-IV-

Infracode and Security:-Infracode, Building Machine Images, Provisioning Infrastructure Resources, Terraform, Configuring Infrastructure Resources, Writing Unit Tests and Integration for Infracode, Managing Identiy, Access and Secrets, Securing Compute Infrastructure and Networking, Recommendations for Security Infracode.

UNIT - V:

Scaling Production Readiness: Monitoring building blocks, Monitoring process, Information Presentation, Developing on-call Resilience, Incident Management, and Capacity Management.

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Textbooks:

1. Jennifer Davis, “Modern System Administration – Building and Maintaining Reliable Systems”, O’Reilly, 2022
2. Jan Schaumann, “Principles of System Administration”, April, 2021
3. Heather Adkins, Besty Beyer, Paul Blankinship, Piotr Lewandowski, Ana Oprea and Adam Stubblefield, “Building Secure & Reliable Systems”, O’Reilly, 2020.

Useful Links:

1. https://www.oreilly.com/library/view/foundations-of-scalable/9781098106058/ch01.html
2. Building Secure and Reliable Systems (googleusercontent.com)
3. principles-of-system-administration.pdf (netmeister.org

Lab Experiments:

1. Installation of Various Linux flavors (optionally using VirtualBox) : CentOS(LVM, without LVM), Ubuntu, Debian
2. Git installation and configuration
3. Local Development Environments
4. Working with Remote Repositories
5. Building Images with Packer/Docker
6. Implementation of different tests including: Infrastructure testing, Production tests, Failover testing, Capacity Testing, Security and Compliance Testing.
7. Configuration of Infrastructure Resources using CFEngine/Chef/Puppet/Salt/RedHat Ansible
8. Configuration of Apache/Nginx for concurrency

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