Asansol Engineering College

R25 [B. Tech CST]

Curriculum & Syllabus for B. Tech under Autonomy
(NEP-2020 Implemented)

CST

(Effective from 2025-26 admission batch)

R25 (B.Tech. CST)

Curriculum & Syllabus for B. Tech under Autonomy

Incorporation of NEP 2020

1st Year 1st Semester (Gr-A)									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/ Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CS101	Introduction to Programming and Problem Solving	3	0	0	3	3
2	SCI	Multi-disciplinary	PH101	Engineering Physics	3	0	0	3	3
3	SCI	Multi-disciplinary	M101	Engineering Mathematics-I	3	0	0	3	3
4	HUM	Value Added Course	HU101	Environmental Science	2	0	0	2	2
5	HUM	Value Added Courses	HU102	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS191	Introduction to Programming and Problem-Solving Lab	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH191	Engineering Physics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	ME194	Engineering Graphics and Computer Aided Design Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU191	Communication and Presentation Skill	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC181	Induction Program	0	0	0	0	0	0
Total of Theory, Practical								24	18

1st Year 2nd Semester (Gr-A)									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	CS201	Data structure and Algorithms	3	0	0	3	3
2	ENGG	Major	CS202	Introduction to Artificial Intelligence	3	0	0	3	3
3	SCI	Multidisciplinary	CH201	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M201	Engineering Mathematics–II	3	0	0	3	3
5	ENGG	Minor	CS203	Digital Logic and Computer Organization	2	0	0	2	2
6	HUM	Value Added Course	HU205	Constitution of India and Professional Ethics	1	0	0	1	1
7	HUM	Ability Enhancement Course	HU203	Design Thinking and Innovation	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS291	Data structure and Algorithms Lab	0	0	3	3	1.5
2.	ENGG	Major	CS292	Introduction to Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH291	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill Enhancement Course	ME293	IDEA LAB Workshop	0	0	3	3	1.5
5	ENGG	Minor	CS293	Digital Logic and Computer Organization lab	0	0	3	3	1.5
C.MANDATORY ACTIVITIES / COURSES									
	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club		0	0	0	0	0
Total of Theory, Practical								29	22

TOTAL FIRST YEAR CREDIT		40

2nd Year 3rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT301	Operating System	3	0	0	3	3
2	ENGG	Major	CT302	Design and Analysis of Algorithms	3	0	0	3	3
3	SCI	Minor	M(CT)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CT)301	Digital Logic and Electronics	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	CT391	Operating System Lab	0	0	3	3	1.5
2	ENGG	Major	CT392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(CT)391	Digital Logic and Electronics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CT393	IT Workshop Lab (SciLab/MATLAB/C++/ Python)	0	1	3	4	2.5
Total of Theory & Practical								25	19

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CT401	Object Oriented Programming	3	0	0	3	3
2	ENGG	Major	CT402	Computer Networks	3	0	0	3	3
3	ENGG	Major	CT403	Database Management Systems	3	0	0	3	3
4	ENGG	Major	CT404	Programming in Python	3	0	0	3	3
5	SCI	Minor	M(CT)401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	CT491	Object Oriented Programming Lab	0	0	3	3	1.5
2	ENGG	Major	CT492	Computer Networks Lab	0	0	3	3	1.5
3	ENGG	Major	CT493	Database Management Systems Lab	0	0	3	3	1.5
4	ENGG	Minor	M(CT)491	Numerical Methods Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(CT)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory & Practical								27	22

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT501	Advanced Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CT502	Web Technology	3	0	0	3	3
3	ENGG	Major	CT503	Software Engineering	3	0	0	4	3
4	ENGG	Major	CT504A	Computer Graphics	3	0	0	3	3
			CT504B	Network Security and Cryptography					
			CT504C	Theory of Computation					
5	HUM	Minor	HU(CT)501	Project Management and Finance	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	CT591	Advanced Artificial Intelligence Lab	0	0	3	3	1.5
2	ENGG	Major	CT592	Web Technology Lab	0	0	3	3	1.5
3	ENGG	Major	CT593	Software Engineering Lab	0	0	3	3	1.5
4		Internship	CT581	Internship/Industrial Training	0	0	2	2	2
5	PRJ	Project	CT582	Project -I	0	0	0	4	2
Total of Theory & Practical								30	22.5

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT601	Deep Learning Techniques	3	0	0	3	3
2	ENGG	Major	CT602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CT603	Digital Image Processing	3	0	0	3	3
4	ENGG	Major	CT604A	Cloud Computing	3	0	0	3	3
			CT604B	Mobile Computing					
			CT604C	Natural Language Processing					
5	HUM	Minor	HU(CT)601	Cyber Law and Ethics	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	CT691	Deep Learning Techniques Lab	0	0	3	3	1.5
2	ENGG	Major	CT692	Machine Learning Lab	0	0	3	3	1.5
3	ENGG	Major	CT693	Digital image processing Lab	0	0	3	3	1.5
4	PRJ	Project	PR681	Project-II	0	0	12	12	6
Total of Theory & Practical								25	26.5

4th Year 7th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT701	Soft Computing	3	0	0	3	3
2	ENGG	Major	CT702A	Data Mining and Warehousing	3	0	0	3	3
			CT702B	Introduction to Internet of Things					
			CT702C	Information Theory and Coding					
3	ENGG	Major	CT703A	Quantum Computing	3	0	0	3	3
			CT703B	Distributed System					
			CT703C	Bio-informatics					
			CT703D	Robotics					
4	HUM	Minor	HU(CT)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	CT791	Soft Computing Lab	0	0	3	3	1.5
2	ENGG	Major	CT792A	Data Mining Lab	0	0	3	3	1.5
			CT792B	Introduction to Internet of Things Lab					
			CT792C	Information Theory and Coding Lab					
3	PRJ	Project	PR781	Project-III	0	0	12	16	8
Total of Theory & Practical								31	22

4th Year 8th Semester									
Sl No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.PRACTICAL									
1			CT881	Grand Viva	0	0	0	8	4
2	PRJ	Project	CT882	Internship/ Entrepreneurship	0	0	12	8	4
Total of Theory & Practical								16	8

Total Credit = 160

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1st Year 1st Semester (Gr-A)									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/ Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CS101	Introduction to Programming and Problem Solving	3	0	0	3	3
2	SCI	Multi-disciplinary	PH101	Engineering Physics	3	0	0	3	3
3	SCI	Multi-disciplinary	M101	Engineering Mathematics-I	3	0	0	3	3
4	HUM	Value Added Course	HU101	Environmental Science	2	0	0	2	2
5	HUM	Value Added Courses	HU102	Indian Knowledge System	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS191	Introduction to Programming and Problem-Solving Lab	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH191	Engineering Physics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	ME194	Engineering Graphics and Computer Aided Design Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU191	Communication and Presentation Skill	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC181	Induction Program	0	0	0	0	0	0
Total of Theory, Practical								24	18

Course Title: Introduction to Programming and Problem Solving
Course Code: CS101
Contact Hours: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objectives

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

- Describe the architecture, memory systems, and evolution of computers.
- Convert between number systems and analyze binary arithmetic including IEEE754 representation.
- Construct algorithms and flowcharts for basic computational problems.
- Implement control structures, arrays, pointers, and functions in C programs.
- Demonstrate structured data types and file I/O using the C programming language.

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

CO1	Describe the architecture, memory hierarchy, and generations of computers, and classify hardware and software components, demonstrating a foundation of engineering knowledge required for understanding computing systems.
CO2	Convert values between number systems and analyze signed and IEEE754 floating-point representations, applying core concepts of mathematics and engineering fundamentals to solve complex engineering problems.
CO3	Construct flowcharts and algorithms for problem solving and develop modular programs in C using appropriate control logic, reflecting skills in design and development of solutions and modern tool usage.
CO4	Implement programs in C using control structures, arrays, pointers, and storage classes, and differentiate between memory management techniques, showcasing proficiency in problem analysis and engineering practice.
CO5	Demonstrate structured data types, file handling, and system-level I/O operations, and evaluate their effectiveness in ensuring data persistence and interfacing with hardware, promoting effective engineering tool usage and lifelong learning.

CO-PO Mapping:

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

Course Content

Module 1: Basics of Computing & Number Representation (7L)

- History and generations of computers
- Classification: Digital, Analog, Hybrid, Micro, Mini, Mainframe
- Computer architecture: Input/Output units, Memory (Primary & Secondary), CPU
- Number systems: Binary, Octal, Decimal, Hexadecimal
- Conversions among number systems
- Signed number representations: 1's, 2's complement
- Floating point representation: IEEE 754 single & double precision

- ASCII codes
- Overview of compiler, interpreter, assembler

Module 2: Problem Solving & Introduction to C Programming (7 L)

- Algorithm, flowchart, and pseudocode
- Procedural vs Structured programming
- C basics: keywords, identifiers, variable naming (Hungarian Notation)
- Data types, constants, declaration, storage size, endianness
- Operators: Arithmetic, Logical, Relational, Bitwise, Conditional
- Operator precedence and type conversions
- Input/Output: scanf(), printf()

Module 3: Control Structures & Program Design (7 L)

- Control structures: if, if-else, switch, nested conditions
- Loops: while, for, do-while, break, continue
- goto and labels (with discussion on structured vs unstructured programming)
- Functions: declaration, definition, prototypes
- Parameter passing, return types, recursion
- Storage classes: auto, static, extern, register
- Preprocessor directives and macros

Module 4: Arrays, Pointers and Strings (8 L)

- Arrays: 1D & 2D, array to function passing
- Pointers: basics, pointer arithmetic, pointer to arrays
- Strings: character arrays, string library functions, array of strings
- Dynamic memory allocation: malloc(), calloc(), realloc(), free()

Module 5: Structured Data Types, File Handling & System Interface (7 L)

- Structures: definition, initialization, array of structures, pointers to structures
- Unions and enum, typedef, bit fields
- File I/O in C: fopen(), fclose(), fprintf(), fscanf(), fgetc(), fputc()
- Command line arguments

Textbook:

1. Schaum's Outline of Programming with C by Byron S. Gottfried, McGraw-Hill Education, 1st Edition (1996)
2. Let Us C by YashavantKanetkar, BPB Publications, 17thEdition
3. Computer Fundamentals by P.K. Sinha and Priti Sinha, BPB Publications,6th Edition

Reference Books:

1. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchiem, Prentice Hall,2ndEdition
2. Fundamentals of Computersby V.Rajaraman and NeeharikaAdabala, PHI Learning, 6th Edition
3. Computer Organization and Architecture: Designing for Performance by William Stallings, Pearson Education,10th Edition
4. Mastering C by K. R. Venugopal and S. R. Prasad, Tata McGraw-Hill Education, 2ndEdition
5. Programming in ANSI C by E. Balagurusamy, McGraw Hill Education 8thEdition

Course Name: Engineering Physics
Course Code: PH101
Contact: (3:0:0)
Total Contact Hours: 36
Credits: 3
Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:
The aim of courses in Physics-I is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11
CO1	3								2		2
CO2	3	3							2		2
CO3	3	3							2		2
CO4	3	3							2		2
CO5	3	3							2		2

Course Content:
Module 1 (11L)
Modern Optics
1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L
1.02-Fibre Optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L
1.03-Holography-Theory of holography (qualitative analysis), viewing of holography, applications 2L

Module 2 (5L)
Solid State Physics
2.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L
2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 2L

Module 3 (14L)
Quantum and Statistical Mechanics
3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: Black body radiation, Photoelectric and Compton Effect: no derivation required), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment, related numerical problems. 5L
3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement). 4L

3.03Statistical Mechanics
Concept of energy levels and energy states, phase space, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)-physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level-Qualitative discussion. 5L

Module 4 (4L)

Physics of Nanomaterials

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment, medical).

Module 5 (2L)

Storage and display devices

Different storage and display devices-Magnetic storage materials, Operation and application of CRT, CRO, LED and OLED.

Text books:

1. Concepts of Modern Engineering Physics- A. S. Vasudeva. (S. Chand Publishers)
2. Engineering Physics - Rakesh Dogra
3. Introduction to Nanoscience and Nanotechnology, An Indian Adaptation-Charles P. Poole, Jr., Frank J. Owens.

Reference books:

1. Optics - Ajay Ghatak (TMH)
2. Solid state Physics - S. O. Pillai
3. Quantum mechanics -A.K. Ghatak and S Lokenathan
4. Fundamental of Statistical Mechanics: B. B. Laud
6. Perspective & Concept of Modern Physics—Arthur Beiser

Course Name: Engineering Mathematics-I
Paper Code: M 101
Contact (L:T:P):3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, coordinate geometry, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply linear algebra methods to perform matrix operations, classify matrix structures, solve systems of linear equations, and compute eigen values and eigenvectors in engineering contexts.
CO2. Apply differential and integral calculus to evaluate and approximate the behavior of single-variable and multivariable real-valued functions relevant to engineering scenarios.
CO3. Analyze the properties of eigen values and eigen vectors to assess matrix diagonalizability and interpret linear transformations using the Cayley-Hamilton theorem in engineering systems.
CO4. Analyze single-variable and multivariable real-valued functions using differential and integral calculus to model and interpret complex behavior in engineering applications.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	3	1	1	-	-	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	2
M101	**3**	**2.5**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

Course Content:

Module I: Liner Algebra (11L)

Echelon form and normal (canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigen values and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaur in theorems with remainders; Taylor's series.

Module III: Multivariable Calculus (Differentiation) (13L)

Function of several variables; Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function; Jacobian; Maxima and minima of functions of two variables.

Module IV: Multi variable Calculus (Integration) (7L)

Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers. Ramana, B.V., Higher Engineering Mathematics, Tata Mc Graw Hill New Delhi, 11th Reprint, 2010.
2. Veerarajan,T.,EngineeringMathematicsforfirstyear,TataMcGraw-Hill,NewDelhi,2008.
3. Bali, N.P. and Goyal, M.,A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. Thomas,G.B.andFinney,R.L.,CalculusandAnalyticgeometry,9thEdition,Pearson, Reprint, 2002.
5. Apostol, M.,Calculus, Volumes1 and2(2ndEdition),Wiley Eastern,1980.
6. Kumaresan, S., Linear Algebra- A Geometric approach, Prentice Hall of India, 2000.
7. Poole, D., Linear Algebra:A Modern Introduction,2nd Edition, Brooks/Cole,2005.
8. Bronson,R.,Schaum'sOutlineofMatrixOperations.1988.
9. Piskunov, N., Differential and IntegralCalculus, Vol.I &Vol.II,Mir Publishers,1969.

Subject Name: Environmental Science
Paper Code: HU 101
Credits: 2
Contact Hours: 24
Prerequisites: 10+2

Course Objective (s)

This course will enable the students to,

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem -solving related to air, water, land and noise pollution.

Course Outcome

CO	Statement
C01	Able to understand the natural environment and its relationships with human activities
C02	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk
C03	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues
CO4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Module 1 - Resources and Ecosystem (6L)

1. **Resources (4L)**

Types of resources, Human resource, Population Growth models: Exponential Growth , Logistic growth curve with explanation. Maximum Sustainable Yield [Derivation]

Alternative sources of Energy [Solar energy, tidal energy, geothermal energy, biomass energy]

2. Ecosystem (2L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Pond eco system, Food chain, Food web.

Module 2 – Environmental Degradation (10L)

1. Air Pollution and its impact on Environment (3L)

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (4L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD [Rate equation], COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal (As, Hg, Pb) poisoning and toxicity. Numerical on BOD, Hardness.

3. Land Pollution and its impact on Environment (1L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio - medical wastes, E-wastes,

4. Noise Pollution and its impact on Environment (2L)

Types of noise, Noise frequency, Noise pressure, Measurement of noise level and decibel (dB) Noise intensity, Noise Threshold limit, Effect of noise pollution on human health. Numerical on Measurement of noise level and decibel (dB) and Noise Threshold limit.

Module 3 – Environmental Management (6L)

1. Environmental Impact Assessment (1L)

2. Pollution Control and Treatment (2L)

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator.

WasteWater Treatment (Surface water treatment &Activated sludge process), Removal of hardness of water (Temporary &Permanent -Permutitprocess).

3. Waste Management (3L)

Solid waste management, Open dumping, Land filling, incineration, composting & Vermicomposting, E-waste management, and Biomedical Waste management.

Module 4 – Disaster Management (2L)

1. Study of some important disasters (1L)

Natural and Man-made disasters, earthquakes, floods drought, landslide, cyclones, volcanic eruptions, tsunami, oil spills, forest fires.

2.Disaster Management Techniques (1L)

Basic principles of disaster management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. Basic Environmental Engineering and Elementary Biology (For MAKAUT),

Gourkrishna Dasmohapatra, Vikas Publishing.

2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.

3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.

2. Environmental Science (As per NEP 2020), Subrat Roy, Khanna Publisher

Paper Name: Indian Knowledge System
Paper Code: HU102
Contact: 1:0:0
Credit: 01
No. of lectures: 12

Course outcome: On completing this course the student will be able

CO1: To define, identify, describe and classify the philosophical, literary and socio-religious heritage of ancient India and the core concepts of the Vedic corpus and way of life.

CO 2: To discover, enumerate, compare, contrast and categorize the importance of pioneering developments in science and mathematics and evaluate their continuing relevance.

CO 3: To analyze, appraise, correlate and describe the ancient Indian heritage in science and technology and examine technological correlations with present-day technological applications.

C0 4: To discover, assess and describe traditional knowledge in health care, architecture, agriculture and other sectors and to explore the history of traditional Indian art forms .

Module-1 **3L**
An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life.
Indian philosophical systems: Different schools of philosophy (Orthodox and Unorthodox).

Module-2 **3L**
Salient features of the Indian numeral system: Developments in Indian Mathematics in ancient India - Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers- Contribution of ancient Indian mathematicians
Highlights of Indian Astronomy: Historical development of astronomy in India- key contributions of ancient Indian astronomers.

Module-3 **3L**
Indian science and technology heritage: Metals and metalworking - Mining and ore extraction – Structural engineering and architecture in ancient India: planning, materials, construction and approaches- Dyes and painting; Shipbuilding.

Module-4 **3L**
Traditional Knowledge in Different Sectors: Traditional knowledge and engineering. Traditional Agricultural practices (resources, methods, technical aids); Traditional Medicine and Surgery; History of traditional Art forms and Culture.

Text Books:
1. Amit Jha . *Traditional Knowledge System in India*. New Delhi: Atlantic Publishers, 2024.
2. B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana . *Introduction to Indian Knowledge System: Concepts and Applications*. New Delhi: PHI, 2022.
3. Angad Godbole. *Science and Technology in Ancient India*. New Delhi: Biblia Implex, 2023.
4. Pritilakshmi Swain. *Indian Knowledge System*. New Delhi: Redshine Publication. 2024.

5. Vishnudut Purohit. *Fundamentals of Indian Knowledge System*. New Delhi: ABD Publishers, 2024.

Reference Books:

1. A. L. Basham. *The Wonder that was India*. Vol. I. New Delhi: Picador, 2019.
2. Arun Kumar Jha and Seema Sahay ed. *Aspects of Science and Technology in Ancient India.* Oxford and New Delhi: Taylor and Francis, 2023.
3.Kapil Kapoor and Awadhesh Kumar Singh. *Indian Knowledge Systems*. Vols. 1 and 2. New Delhi: D. K. Printworld, 2005.
4. S. N. Sen and K. S. Shukla, *History of Astronomy in India*. New Delhi: Indian National Science Academy, 2nd edition, 2000.
5. Arpit Srivastava. *Indian Knowledge System*. Rewa: AKS University, 2024.

CO-PO Mapping:

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

Course Title: Introduction to Programming and Problem Solving Lab
Course Code: CS191
Contact Hours: 0:0:3
Total Contact Hours: 36
Credits: 1.5

Course Objectives

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

- Understand the fundamentals of programming logic through algorithmic thinking.
- Implement and debug C programs using various control structures.
- Apply memory management concepts using pointers and arrays.
- Develop structured programs involving functions and recursion.
- Demonstrate file operations and manipulate data using structures and pointers.

Course Outcomes (COs)

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

CO1	Identify fundamental programming constructs such as data types, operators, control structures, and apply them to solve basic computational problems.
CO2	Design modular programs using functions, arrays, and structures, and develop reusable solutions to solve real-world problems.
CO3	Demonstrate the use of pointers and dynamic memory management to analyze memory-efficient solutions for complex problems.
CO4	Construct file-based applications that enable persistent data storage and illustrate communication of results through formatted outputs.
CO5	Integrate multiple programming concepts to create a functional mini-project, demonstrating teamwork, project management skills, and adaptability to emerging challenges.

CO-PO Mapping:

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

Course Content

Lab No.	Title / Experiment	Learning Focus
1	Introduction to C, Basic Input/Output, Data Types, and Operators	I/O operations, operator 1precedence, expressions
2	Problems on Conditionals: if, if-else, nested if, switch-case	Decision-making constructs
3	Looping Constructs: for, while, do-while	Iterative problem solving

4	Nested Loops: Pattern Printing, Series Problems	Logical structuring using loops
5	Functions: call by value, return types, recursion	Modular programming and recursion
6	Arrays: 1D and 2D array manipulation, search/sort problems	Data storage and iteration
7	Strings: string manipulation functions, array of strings	Character arrays and string operations
8	Pointers: pointer arithmetic, pointers with arrays and functions	Memory-level data access
9	Dynamic Memory Allocation using malloc(), calloc(), free()	Runtime memory management
10	Structures and Unions: defining, accessing, array of structures, pointer to structure.	Composite data types and access
11	File I/O: fopen(), fprintf(), fscanf(), fgetc(), fputc()	Persistent data storage
12	Mini Project: Combining structures, functions, and file I/O for a real-world scenario	Integration and application of concepts

Textbook:

4. Schaum's Outline of Programming with C by Byron S. Gottfried, McGraw-Hill Education, 1st Edition (1996)
5. Let Us C by YashavantKanetkar, BPB Publications, 17thEdition

Reference Books:

6. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchiem, Prentice Hall,2ndEdition
7. Mastering C by K. R. Venugopal and S. R. Prasad, Tata McGraw-Hill Education, 2ndEdition
8. Programming in ANSI C by E. Balagurusamy, McGraw Hill Education 8thEdition

Course Name: Engineering Physics Lab

Course Code: PH191

Contact: (0:0:3)

Total Contact Hours: 36

Credits: 1.5

Prerequisites: Knowledge of Physics up to 12^{th} standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies

Course Content:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide callipers/ Screw-gauge/travelling microscope for one experiment.

Experiments on Classical Physics (Any 4 to be performed from the following experiments):

1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.

2. Determination of Young's moduli of different materials.

3. Determination of Rigidity moduli of different materials.

4. Determination of wavelength of light by Newton's ring method.

5. Determination of wavelength of light by Laser diffraction method.

6. Optical Fibre-numerical aperture, power loss.

Experiments on Quantum Physics (Any 2 to be performed from the following experiments):

7. Determination of Planck's constant using photoelectric cell.

8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

9. Determination of Stefan's Constant.

10a. Study of characteristics of solar cell (illumination, areal, spectral)

10b. Study of characteristics of solar cell (I-V characteristics, Power-load characteristics, Power-wavelength characteristics)

Perform at least one of the following experiments:

11. Determination of Q factor using LCR Circuit.

12. Study of I-V characteristics of a LED/LDR.

13. Determination of band gap of a semiconductor.

**In addition, it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as

Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of the specific charge of the electron (e/m) from the path of an electron beam by Thomson method.
2. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor3. Study of dispersive power of material of a prism.

3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.

4. Determination of the angle of optical rotation of a polar solution using polarimeter.

5. Any other experiment related to the theory.

Course Outcomes

After completion of this course the students will be able to

CO1:
Determine mechanical properties such as Young's modulus and rigidity modulus through hands-on experiments and *analyze* material behaviour under applied forces.
BT Level: Applying (L3), Analyzing (L4)
Mapped to: Torsional pendulum, Young's modulus, Rigidity modulus

CO2:
Perform optical experiments including Newton's Rings, laser diffraction, and optical fiber characterization, and *interpret* the results based on wave optics principles.
BT Level: Applying (L3), Analyzing (L4)
Mapped to: Newton's Rings, Laser Diffraction, Optical Fiber

CO3:
Investigate quantum effects such as the photoelectric effect and atomic transitions, and *relate* experimental outcomes to basic quantum principles.
BT Level: Understanding (L2), Applying (L3)
Mapped to: Photoelectric Effect, Frank-Hertz, Stefan's Constant

CO4:
Study the performance of semiconductor and electronic devices like solar cells, LEDs, and LCR circuits, and *investigate* their operational characteristics.
BT Level: Applying (L3), Analyzing (L4)
Mapped to: Solar Cell, LED/LDR, LCR Circuit, Band Gap

CO5:
Conduct experiments such as Hall Effect, e/m determination, prism dispersion, or optical rotation to *demonstrate* the application of advanced physical principles in practical scenarios.
BT Level: Applying (L3), Analyzing (L4)
Mapped to: Hall Effect, e/m, Prism, Thermal Conductivity, Polarimeter

CO-PO Mapping

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

Recommended Text Books for Engineering Physics Lab:

Waves & Oscillations:

1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit Classical & Modern Optics:

2. A text book of Light- K.G. Mazumder & B.Ghosh (Book & Allied Publisher)

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House) Solid

State Physics:

1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)

2. Practical Physics by K.G. Mazumder (New Central Publishing) 3. Practical Physics by R. K. Kar (Book & Allied Publisher)

COURSE NAME: ENGINEERING GRAPHICS & COMPUTER AIDED DESIGN LAB
COURSE CODE: ME194
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

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

CO1: Use common drafting tools with the knowledge of drafting standards
CO3: Understand the concepts of engineering scales, projections, sections.
CO4: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints
CO5: Produce part models; carry out assembly operation and represent a design project work.

Course Contents:

Basic Engineering Graphics: **3P**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing **6P**

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections **6P**

Principles of Orthographic Projections -Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes - Auxiliary Views; Isometric Scale, I sometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice- versa.

Module 3: Sections and Sectional Views of Right Angular Solids **6P**

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic view s of objects from industry and dwellings (foundation to slab only).

Computer Graphics: **3P**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co -ordinate Systems; Multi -view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics **3P**

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering 6P

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project 3P

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2			2							
CO2	2			2							
CO3	3			2							
CO4	3			3							
CO5	3	2		3	2						

Paper Name: **Communication and Presentation Skill**
Paper Code: **HU191**
Contact: (0:0:3)
Total Contact Hours: 36
Credit: 1.5

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:
By pursuing this course the students will be able to:
CO1: Recognize, identify and express advanced skills of Technical Communication in English and Soft Skills through Language Laboratory.
CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.
CO3: Analyze, compare and adapt the skills necessary to be a competent interpersonal communicator in academic and global business environments.
CO4: Deconstruct, appraise and critique professional writing documents, models and templates.
CO5: Adapt, negotiate, facilitate and collaborate with communicative competence in presentations and work-specific conclaves and interactions in the professional context.

Course Contents:

Module 1: Introduction Theories of Communication and Soft Skills
a. Communication and the Cyclic Process of Communication (Theory, benefits and application)
b. Introduction to Workplace Communication (Principles and Practice)
c. Non-Verbal communication and its application
c. Soft Skills Introduction: Soft-Skills Introduction
What is Soft Skills? Significance of Soft-Skills
Soft-Skills Vs. Hard Skills
Components of Soft Skills
Identifying and Exhibiting Soft-Skills (Through classroom activity)

Module 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c.Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening.
d. Listening in Business Telephony and Practice
Practical (Role plays, case studies)

Module 3: Speaking Skills

a. Effective Public Speaking: Public Speaking, Selecting the topic for public speaking, (Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, delivering the speech, Voice Clarity). Practical (Extempore)
Self Learning Topics: Preparation, Attire, Posture and Delivery techniques

b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focused activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Group Discussion: Principles, Do's and Don'ts and Practice;

Module 4: Writing and Reading Comprehension
a. Reading and Writing a Book Review (classroom activity)
b. Writing a Film Review after watching a short film (classroom activity)
c. Reading Strategies: active reading, note-taking, summarizing, and using visual aids like diagrams and graphs
d. Solving Company-Specific Verbal Aptitude papers.(Synonyms, Antonyms, Error Correction and RC Passages)

Module 5: Presentation Skills
Kinds of Presentation. Presentation techniques, planning the presentation,
Structure of presentation: Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management, Visual aids.

- Self Introduction, Creation of Video Resume`
- Need for expertise in oral presentation.•Assignment on Oral presentation.
- Rules of making micro presentation (power point). Assignment on micro presentation

Text Books:
1. Pushp Lata and Sanjay Kumar. *A Handbook of Group Discussions and Job Interviews*. New Delhi: PHI, 2009.
2. Jo Billingham. *Giving Presentations*. New Delhi: Oxford University Press, 2003.
3. B. Jean Naterop and Rod Revell. *Telephoning in English*. 3rd ed. Cambridge: Cambridge University Press, 2004.
4. Jeyaraj John Sekar. *English Pronunciation Skills: Theory and Praxis*. New Delhi: Authorspress, 2025.
5. Career Launcher. *IELTS Reading: A Step-by-Step Guide*. G. K. Publications. 2028

Reference Books:

1. Ann Baker. *Ship or Sheep? An Intermediate Pronunciation Course*. Cambridge: Cambridge University Press, 2006.
2. Barry Cusack and Sam McCarter. *Improve Your IELTS: Listening and Speaking Skills.* London: Macmillan, 2007.
3. Eric H. Glendinning and Beverly Holmström. *Study Reading.* Cambridge: Cambridge University Press, 2004.
4.Malcolm Goodale. *Professional Presentations*. New Delhi: Cambridge University Press, 2005.
5. Mark Hancock. *English Pronunciation in Use*. Cambridge: Cambridge University Press, 2003.

1st Year 2nd Semester (Gr-A)									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	CS201	Data structure and Algorithms	3	0	0	3	3
2	ENGG	Major	CS202	Introduction to Artificial Intelligence	3	0	0	3	3
3	SCI	Multi-disciplinary	CH201	Engineering Chemistry	2	0	0	2	2
4	SCI	Multi-disciplinary	M201	Engineering Mathematics–II	3	0	0	3	3
5	ENGG	Minor	CS203	Digital Logic and Computer Organization	2	0	0	2	2
6	HUM	Value Added Course	HU205	Constitution of India and Professional Ethics	1	0	0	1	1
7	HUM	Ability Enhancement Course	HU203	Design Thinking and Innovation	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	CS291	Data structure and Algorithms Lab	0	0	3	3	1.5
2.	ENGG	Major	CS292	Introduction to Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH291	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Skill Enhancement Course	ME293	IDEA LAB Workshop	0	0	3	3	1.5
5	ENGG	Minor	CS293	Digital Logic and Computer Organization lab	0	0	3	3	1.5
C.MANDATORY ACTIVITIES / COURSES									
	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club		0	0	0	0	0
Total of Theory, Practical								29	22
TOTAL FIRST YEAR CREDIT									40

Course Name: Data Structures and Algorithms
Course Code: CS201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory.

Course Objective(s):

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

- Gain a strong foundation in data abstraction, data types, and data structures, and understand the importance of structured data organization in solving engineering problems.
- Formulate and analyze algorithms, perform asymptotic analysis using Big O, Θ (Theta), and Ω (Omega) notations, and comprehend the trade-offs between time and space complexities.
- Design and implement linear and non-linear data structures such as arrays, linked lists, stacks, queues, trees, heaps, and graphs, and apply them effectively in computational problem-solving.
- Evaluate and compare various searching, sorting, and hashing algorithms based on their performance, and choose appropriate methods for optimized data handling.
- Appreciate the role of data structures in real-world applications, foster a mindset of lifelong learning, and develop the adaptability to utilize modern programming tools and emerging technologies.

Course Outcomes (COs):

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

CO1	Apply fundamental knowledge of data types, abstract data types, and data structures to analyze real-world computational problems and their memory/time constraints.
CO2	Design and implement linear data structures (arrays, linked lists, stacks, queues) using appropriate programming constructs to solve well-defined problems efficiently.
CO3	Develop recursive algorithms and simulate stack-based computations such as expression conversion and evaluation using appropriate engineering tools.
CO4	Construct and evaluate non-linear data structures (Binary Tree, BST, AVL Tree, heaps, graphs) and associated operations (search, insertion, deletion, traversal) to address complex engineering problems.
CO5	Compare and optimize sorting, searching, and hashing algorithms based on performance analysis and recognize their suitability in dynamic problem contexts to support life-long learning.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction 4L
Concepts of data and information; Concept of Abstract Data Type, Data Structure and Data Type. Classification of Data Structures- Primitive and Non-Primitive Data Structure, Linear and Non-Linear Data Structure. Need of Data Structures.
Concept of algorithms and programs, Different methods of representing algorithm; Algorithm analysis, time and space analysis of algorithms – Asymptotic notations like Big Oh (O), Small Oh(o), Big Omega(Ω), Small Omega(ω) and Theta(Θ) notation (definition and significance).

Module 2: Non-Restricted Linear Data Structure9L
List or Linear List: Definition and Example, List as ADT. Representation of Linear List- Sequential Representation and Linked Representation.
Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array.
Linked List: Introduction to linked representation, Implementation of different types of linked list- Singly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation of polynomial.

Module 3: Restricted Linear Data Structure 6L
Stack: Definition of Stack, implementations of stack using array and linked list
Applications of stack- infix to postfix conversion, Postfix Evaluation
Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.
Queue: Definition of Queue; Implementation of queue using array-physical, linear and circular model; Implementation of queue using linked list.
Dequeue - Definition and different types of dequeue.

Module 4: Nonlinear Data structures 9L
Trees and Binary Tree:
Basic terminologies; Definition of tree and binary tree. Difference between tree and binary tree, Representation of binary tree (using array and linked list)
Binary tree traversal (pre-, in-, post- order); Threaded binary tree- definition, insertion and deletion algorithm; Binary search tree- Definition, insertion, deletion, searching algorithm;
Height balanced binary tree: AVL tree- definition, insertion and deletion with examples only.
m –Way Search Tree: B Tree – Definition, insertion and deletion with examples only; B+ Tree – Definition, insertion and deletion with examples only.
Heap: Definition (min heap and max heap), creation, insertion and deletion algorithm. Application of heap (priority queue and sorting).
Graphs: Definition and representation (adjacency matrix, incidence matrix and adjacency list).
Graph traversal– Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge).

Module 5: Sorting and Searching 8L
Sorting Algorithms: Definition and need of sorting, different types of sorting algorithm (internal, external, stable, in-place, comparison based); Factors affecting sorting Methods, Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort – algorithm with analysis (time complexity)
Searching: Factors affecting searching Methods; Sequential search –algorithm with analysis (time complexity); improvement using sentinel.
Binary search and Interpolation Search algorithm with analysis (time complexity)
Hashing: Introduction and purpose of Hashing and Hash functions (division, folding and mid-square), Collision resolution techniques.

Text book:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, SartajSahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures and Program Design in C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
4. Data Structures in C by Aaron M. Tenenbaum, 1St Edition, Pearson

Course Name	**Introduction to Artificial Intelligence**
Course Code	**CS202**
Contact Hours (Period/week)	**2**
Total Contact Hours	**30**
Credit	**2**

Course Objectives:

The objectives of this course are to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context.
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes (COs):

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

CO1	**Understand and explain** the fundamental concepts of **Knowledge Representation** and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing **Model/Agent** Design Framework within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.
CO5	**Implement** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

Course Contents:

Module 1: Introduction to Artificial Intelligence (3 Lectures)

Why AI • Definition of AI • Goals of AI • History and evolution of AI • Types of AI: Narrow, General, Super • Human vs Artificial Intelligence • Applications of AI in various domains • AI for social good

Module 2: Intelligent Agents and Logic-Based Thinking (8 Lectures)

Intelligent systems • Agents and environments • Decision making using rules and logic • Symbolic AI concepts • Propositional Logic: Knowledge Representation and Inference using Propositional Logic • Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module 3: Overview of AI Branches and Perception (8 Lectures)

Machine learning • Deep learning • Natural language processing • Computer vision • Expert systems • Fuzzy logic • Evolutionary algorithms • Reinforcement learning • Planning and scheduling • Human-AI collaboration

Module 4: **Basics of Machine Learning (6 Lectures)**

What is machine learning • AI vs ML • Types of learning: supervised, unsupervised • Concept of dataset, features, and labels • ML model and prediction flow • Common ML applications • Introduction to decision trees (concept only) • ML pipeline overview.

Module 5: **Applications and Ethics of AI (5 Lectures)**

AI in robotics and automation • AI-enabled smart applications • Industry 4.0 and intelligent systems • AI in different sectors: healthcare, agriculture, transport, education, etc. • Human-AI teamwork • Basics of AI ethics: bias, fairness, privacy • Career opportunities and future scopes in AI.

Textbook:

Saptarsi Goswami , Amit Kumar Das , Amlan Chakrabarti - **AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI),** Pearson**.**

Rich, E., Knight, K and Shankar, B. 2009. **Artificial Intelligence**, 3rd edition, Tata McGraw Hill.

Russell , S. and Norvig , P. 2015. **Artificial Intelligence - A Modern Approach**, 3rd edition, Prentice Hall.

Reference Books:

Reema Thareja, **Artificial Intelligence**: Beyond Classical AI, Pearson.

Patterson , **Introduction to Artificial Intelligence and Expert Systems,** Pearson.

CO–PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2	-	-	-	-	-	2	2	2	3

Course Name: ENGINEERING CHEMISTRY
Paper Code: CH 201
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2

COURSE OBJECTIVE

- Understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.
- Apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.
- Apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.
- Analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.
- Evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices

COURSE OUTCOME

CO1. Able to understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.

CO2. Able to apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.

CO3. Able to apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.

CO4. Able to analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.

CO5. Able to evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices.

COURSE CONTENT

Module 1

Quantum Properties of Atoms (4 L)

Schrodinger Wave Equation (time independent – basic principles only), de Broglie Equation, Heisenberg Uncertainty Principle, Quantum Numbers, Effective nuclear charge, Slater's rule, penetration of orbitals,

variations of orbital energies in the periodic table, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, oxidation properties.

Chemistry of materials (2L)

Semiconductor-Based Memory Materials (Si & Ge) [Introduction, Properties and role of Si & Ge), Intensive & Extensive semiconductor,

Module II

Chemical Thermodynamics (5L)

1st & 2nd Law of Thermodynamics, Tendency for maximum randomness, Carnot Heat Engine [Derivation], Entropy characteristics, Mathematical explanation & physical significance of Entropy, Entropy change of ideal gas for isothermal reversible process, Gibbs free Energy Function, Standard free Energy, Criterion of spontaneity.

Electricity production through chemical reactions (2L)

Electrochemical Cell, writing of cell notation, free energy and EMF, Criterion of spontaneity in terms of Cell,

Nernst equation (only expression, no derivation) and applications, calculation of EMF of a cell, calculation of single electrode potential, calculation of Kc, calculation of Kc from G^0.

Working principle and applications of Lithium-ion batteries

Module III

Polymers for Engineering Applications (3L)

Polymers and their classifications (based on origin, chemical structure, polymeric structure, tacticity and molecular forces)

Commercially important polymers: Synthesis and applications of Bakelite, nylon 6,6, HDPE & LDPE

Conducting polymers –Types examples and applications.

Biodegradable polymers –definition, example and uses

Industrial Chemistry (3L)

Types of corrosion, Electrochemical theory of corrosion, rusting of iron, comparison of chemical & electrochemical corrosion. [Mechanism excluded]

Factors affecting the rate of corrosion; nature of metal (physical state, purity, position in Galvanic series) & environment.

Corrosion control: Cathodic protection, anodic protection, Inorganic coatings.

Classification of Fuel (LPG, CNG, BIOGAS), Calorific value, Octane number, Cetane number, HCV, LCV. [Definition only]

Module IV

Organic Reactions & synthesis of drugs (3L)

Acidity and basicity comparison of organic compounds(acids, alcohols & amines), Nucleophilic Substitution reaction and Electrophilic Addition reactions, Markonikov's rule, peroxide effect, Synthesis of Paracetamol & Aspirin and uses.(Name reactions are not in syllabus)

Spectroscopy (2L)

Electromagnetic spectrum, Lambert-Beer Law, Finding of λ max value & concentration of the unknown solution, Applications of UV-VIS spectroscopy, Chromophores & Auxochromes.

Applications of IR spectroscopy, Fingerprint region

Suggested Text Books

- Chemistry –I, Gourkrishna Das Mohapatro
- A text book of Engineering Chemistry, Dr. Rajshree Khare
- Engineering Chemistry, U. N. Dhar
- Physical Chemistry, P.C. Rakshit

Reference Books

- Engineering Chemistry, Jain & Jain
- Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishna
- Text book of Engineering Chemistry, Jaya Shree Ani reddy

Course Name: Engineering Mathematics- II
Paper Code: M 201
Contact (L: T: P): 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:

The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply analytical methods to solve ordinary differential equations in engineering contexts.
CO2. Apply the properties and inverse of Laplace Transforms to compute improper integrals and determine solutions of linear ordinary differential equations with constant coefficients in engineering scenarios.
CO3. Apply numerical methods to interpolate data, perform numerical integration, and solve ordinary differential equations in engineering applications.
CO4. Analyze the behavior of solutions using analytical and numerical approaches, including Laplace transforms, to assess stability, convergence, and accuracy in engineering contexts.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	3	1	1	-	-	-	-	-	-	2
M 201	**3**	**2.25**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**

Weightage Values: Strongly mapped: '3', Moderately mapped: '2', Weakly mapped: '1', Not mapped: '-'.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE) (9L)
Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation.
Solution of first order and higher degree ODE: solvable for$p$, solvable for y and solvable for $x$and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE) (8L)
Solution of second order ODE with constant coefficients: Complementary Function and Particular Integral, Method of variation of parameters, Cauchy-Euler equations.

Module III: Laplace Transform (LT) (12L)
Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $tf(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improperintegrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties,Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution oflinear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods (7L)

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation. **Numerical integration:** Trapezoidal rule, Simpson's $1/3$ Rule. **Numerical solution of ordinary differential equation:** Euler method, Fourth order Runge-Kutta method.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Course Title: Digital Logic and Computer Organization
Course Code: CS203
Contact Hours: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objectives

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

- To introduce number systems, logic gates, and design of combinational and sequential circuits.
- To develop an understanding of data processing using micro-operations and instruction formats.
- To explain how CPU, memory, and I/O units are organized and interact during instruction execution.
- To describe arithmetic algorithms and control unit designs in processor architecture.
- To build a foundation for advanced topics like microprocessors, computer architecture, and embedded systems.

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

CO1	Explain various number systems and coding schemes, and apply Boolean algebra laws and Karnaugh Maps to simplify logical expressions.
CO2	Design and construct combinational and sequential logic circuits including adders, multiplexers, flip-flops, and counters for implementing digital functions.
CO3	Develop and analyze data path units such as ALU, control units, and register organizations to support instruction execution in CPU architectures.
CO4	Demonstrate arithmetic operations like Booth's multiplication and division, and illustrate various addressing modes and instruction formats used in CPUs.
CO5	Compare memory hierarchy systems and I/O techniques, and evaluate their role in enhancing overall processor performance.

CO-PO Mapping:

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

Course Content

Module 1: Number Systems, Boolean Algebra, and Logic Simplification (6 L)

- Binary, BCD, ASCII, EBCDIC, Gray Code & conversions [1L]
- Boolean Algebra – Laws, Theorems [1L]
- Boolean Functions, Minterm&Maxterm, SOP & POS Forms [2L]
- Karnaugh Map (up to 4-variable), Algebraic Simplification [2L]

Module 2: Combinational Circuits (6 L)

- Half & Full Adder/Subtractor, Serial & Parallel Adders, CLA Adder [2L]
- Parity Generator, Encoder, Decoder, Multiplexer, Demultiplexer [2L]
- Comparator, Code Converters [2L]

Module 3: Sequential Circuits & Registers (6 L)

- Flip-Flops: SR, JK, Master-Slave JK, D, T; Characteristic & Excitation Tables [2L]
- Counters: Synchronous/Asynchronous, Ring & Johnson, Mod-N Counters [2L]
- Registers: SISO, SIPO, PIPO, PISO [1L]
- Applications of Counters and Registers [1L]

Module 4: Data Representation & Arithmetic Operations (5L)

- Integer Arithmetic (Add, Subtract), Booth's Multiplication Algorithm [2L]
- Restoring & Non-Restoring Division [1L]
- Instruction Formats and Addressing Modes [2L]

Module 5: CPU and Control Unit Organization (6 L)

- Register Transfer Language (RTL), Bus Architecture, Micro-operations [1L]
- ALU Design, Status Flags, General Register & Stack Organization [2L]
- Control Unit: Hardwired vs. Microprogrammed Control, Sequencing [2L]
- Basic Instruction Cycle and Execution Pipeline [1L]

Module 6: Memory & I/O Organization (7L)

- RAM, ROM Types, Memory Hierarchy: Cache, Main, Secondary [1L]
- Cache Mapping: Direct, Associative, Set-Associative; Write Policies [3L]
- Virtual Memory: Paging, Segmentation, FIFO & LRU [1L]
- I/O Transfer Modes: Programmed I/O, Interrupt-Driven I/O, DMA [1L]
- Interrupts: Maskable/Non-Maskable, Daisy Chaining; I/O Processor [1L]

Textbooks:

1. Digital Logic and Computer Design by M. Morris Mano,Pearson Education, 1st Edition
2. Computer Organization and Architecture: Designing for Performance by William Stallings,Pearson Education, 10th Edition

Reference Books:

1. Digital Design by M. Morris Mano, Michael D. Ciletti, Pearson Education, 5th Edition
2. Computer Organization and Embedded SystemsByCarl Hamacher, ZvonkoVranesic, SafwatZaky,McGraw-Hill Education, 6th Edition
3. Computer Organization and Design: The Hardware/Software InterfaceBy David A. Patterson, John L. Hennessy, Morgan Kaufmann Publishers, RISC-V Edition
4. Fundamentals of Logic Design by Charles H. Roth Jr., Larry L. Kinney,Cengage Learning, 7th Edition
5. Digital Fundamentals by*Thomas L. Floyd,* Pearson Education, 11th Edition

Paper Name: **Constitution ofIndia and Professional Ethics**

Paper Code: HU205

Contact: 1:0:0

Credit: 1

Total Lectures: 12

Prerequisites:
Basic knowledge (10+2 level) of the Indian Constitution and moral science.

Course outcome: On completing thiscourse the student will be able to

CO1: Identify, define and understand the significance of the Constitution of India, its spirit and values and the fundamental rights and duties as a responsible citizen.
CO2: define and discover core ethical concepts, the basic perception of profession, and professional ethics that shape the ethical behavior of an engineer.
CO3: identify, examine and apply codes of engineering ethics, engineers' social responsibilities and industrial standards and ethical dilemmas.
CO4: consider, correlate and appraise ethical leadership and principles in addressing gender issues, concerns of IPR and industrial responsibilities.

Module 1: **2L**

Preamble : Salient Features, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliament -Powers and Functions –Executive- President -Governor - Council of Ministers.

Module 2: **3L**

Introduction to Ethical Thinking; what is Ethics, Work ethic s; Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success.

Module 3: **4L**

Engineering Ethics, Ethical theories: a brief overview; utilitarianism, deontology, virtue ethics. Professional Codes, Codes of professional ethics-Moral dilemmas, and moral autonomy- Internal ethics of business: whistle blowing, conflicts of interest, Job discrimination, and Exploitation of Employees; Social and ethical responsibilities of technologists: Responsibilities towards Customers, shareholders, employees – Social Audit.

Case Studies: Bhopal Gas Tragedy, Chernobyl (linking ethics to real-world failures).

Module 4: **3L**

Business ethics, ethical decision-making frameworks - Impact of ethics on business policies and strategies- Characteristics of ethical leaders; fostering integrity in teams; Addressing occupational crime, discrimination, and gender-based issues in workplaces-Intellectual property rights (IPR), Plagiarism and Academic Misconduct.

Text Books:

1.Durga Das Basu. *Introduction to the Constitution of India*. 27th ed. New Delhi: Lexis Nexis, 2024.
2. R.S Naagarazan. *A Textbook on Professional Ethics and Human Values*. New Age International (P) Limited, 2022.
3. N. Subramanian. *Professional Ethics.* New Delhi: Oxford University Press, 2017.
4. A N Tripathi, *Human Values*. New Delhi: New Age Publishers, 2019.
5. S. K. Chakraborty. *Values and Ethics for Organizations: Theory and Practices*. New Delhi: Oxford University Press, 1997.

Reference Books:

1.O. C. Ferrell, John Friaedrich and Linda Ferrell. *Business Ethics: Ethical Decision Making and Cases.* New Delhi: Cengage India, 2024.
2.Charles Fledderman. *Engineering Ethics*. 3rd ed. New Delhi: Pearson Education, 2007.
3.Dinesh G. Harkut and Gajendra R. Bamnote. *Professional Ethics for Engineers*. Chennai: Notion Press, 2023.
4.U.C.Mathur, *Corporate Governance and Business Ethics*: *Text and Cases*. Chennai: Macmillan, 2012.
5. Fernando. A. C., K. P. Muralidheeran and E. K. Satheesh. *Business Ethics – An Indian Perspective*. New Delhi: Pearson Education, 2019.

CO-PO Mapping:

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

Course Title	**Design Thinking and Innovation**		
Course Code	HU203		
(L-T-P)	(2-0-0)		
Class Hours / Week	02		
Total class hours	30		

Course Objective:

The objective of this Course is to provide new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products and services which are useful for a student in preparing for an engineering career.

Course Outcomes (COs): Upon completion of the course, students shall be able to

Sl. No.	Course outcomes	Mappingto POs
1.	Analyze emotional experience and expressions to better understand stakeholders whiledesigning innovative products through group brainstorming sessions.	PO1, PO2, PO4, PO5, PO7, PO8 & PO9
2.	Generate and develop design ideas through different technique	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10 & PO11
3.	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing any innovative products using facility in AICTE IDEA LAB	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10 & PO11

CO-PO MAPPING:

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

Prerequisites:

For a course on the Basics of Design Thinking, students should ideally possess basic computer skills, communication abilities, problem -solving aptitude, critical thinking, introductory knowledge of Sustainable Development Goals, curiosity, and openness to new ideas, as well as basic understanding of mathematics, technology, and manufacturing processes.

However, even if these prerequisites are not satisfied, the faculty will cover them in the first few classes.

An awareness of 21st-century skills, including creativity and collaboration, is also beneficial.

These prerequisites aim to provide a foundation, and any gaps in knowledge will be addressed by the instructor early in the course.

SYLLABUS:

Module	Content	Hour
Module 1:	**Basics of Design Thinking:** Definition of Design Thinking, Need for Design Thinking, history of Design Thinking, Concepts & Brainstorming , 2X2 matrix, 6 -3-5 method, NABC method;	3
Module 2:	**PROCESS OF DESIGN: Understanding Design thinking** Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping.	6

Module 2:	**PROCESS OF DESIGN: Understanding Design thinking** Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping. Stages of Design Thinking Process (explain with examples) – Empathize (Methods of Empathize Phase: Ask 5 Why / 5W+H questions, Stakeholder map, Empathy Map, Peer observation, Trend analysis). Define (Methods of Define Phase: Storytelling, Critical items diagram, Define success). Ideate (Brainstorming, 2X2 matrix, 6-3-5 method, NABC method). Prototype (Types of prototypes - Methods of prototyping - Focused experiments, Exploration map, Minimum Viable Product). Test (Methods of Testing: Feedback capture grid, A/B testing).	6
Module 3:	**Tools for Design Thinking** Real-Time design interaction captures and analysis – Enabling efficient collaboration in digital space– Empathy for design – Collaboration in distributed Design	3
Module 4:	**Design Thinking in IT** Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenariobased Prototyping	2
Module 5:	**Design Thinking For strategic innovations** Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model	3
Module 6:	**Problem Solving & Critical thinking** Introduction to TRIZ, SCAMPER, UI and UX.	2
Module 7:	**Sustainable development goals (SDG)** Integrating and mapping 17 Sustainable development goals (SDG) during designing a product; goods or service. Introduction to 21st Century Skill Set	1
Module 8:	**Case Study & Project Report Submission**	10

Text Books :

1. Karmin Design Thinking by Dr. Bala Ramadurai, Mudranik Technology Private Ltd. ISBN 978-93-5419-0I0-0.
2. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
3. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
4. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins e-books, 2009.

Course Title: Data Structures and Algorithms Lab

Course Code: CS291
Contact Hours: 0:0:3
Credits: 1.5

Course Objectives

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

- To develop skills in implementing and analyzing data structures using C.
- To gain hands-on experience in solving problems using arrays, linked lists, stacks, queues, trees, graphs, and hashing.
- To apply algorithmic concepts like recursion, sorting, and searching in solving real-world problems.

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

CO1	Apply fundamental programming concepts to construct and manipulate linear data structures like arrays, linked list, stacks, and queues for solving structured problems.
CO2	Develop and analyze non-linear data structures such as binary search trees to address hierarchical and dynamic memory-based problems.
CO3	Implement recursive algorithms to solve classical problems like Tower of Hanoi and Fibonacci series, demonstrating critical thinking and abstraction.
CO4	Compare and evaluate various sorting and searching algorithms based on time and space complexity for performance-critical applications.
CO5	Design and integrate suitable data structures to build efficient software modules, demonstrating teamwork, project planning, and communication of technical results.

CO-PO Mapping:

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

Course Content

Lab No.	Title	Topics / Experiments
1	Introduction to C Revisions	Basic C programming constructs, functions, pointer concepts.
2	Arrays and Polynomial Representation	Create, access and manipulate 1D, 2D arrays; polynomial representation using arrays.
3	Linked Lists	Singly Linked List: creation, insertion, deletion, search.
4	Doubly & Circular Linked Lists	Implement doubly linked and circular linked list with insertion/deletion.
5	Stacks (Array & Linked List)	Implement stack using array and linked list.
6	Application of Stack	infix to postfix conversion, postfix evaluation.
7	Queues (Array & Linked List)	Physical, Linear and circular model of queues using array, Queue Using linked list.
8	Recursion Applications	Factorial, Fibonacci, Tower of Hanoi.

9	Binary Search Tree (BST)	Insertion, deletion, searching; height of tree.
10	Sorting Algorithms	Implement of bubble sort, insertion sort, and selection sort.
11	Sorting Algorithms	Implement of quick, merge sort, and radix sort.
12	Searching and Hashing	Linear search, binary search, interpolation search;

Text book:

3. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Edition: 2001, BPB Publications
4. Fundamentals of Data Structures of C by Ellis Horowitz, SartajSahni, Susan Anderson-freed 2nd Edition, Universities Press

Reference Books:

5. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition, Pearson.
6. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
7. Data Structures and Program Design in C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson
8. Data Structures in C by Aaron M. Tenenbaum, 1St Edition, Pearson

Course Name	**Introduction to Artificial Intelligence Lab**
Course Code	**CS292**
Contact Hours (Period/week)	**3L/Week**
Total Contact Hours	**30**
Credit	**1.5**

Course Objectives:

The objectives of this course are to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State -Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies

Course Outcomes (COs):

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

CO1	**Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** its utilitarian importance in current technological context leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State -Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	**Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	**Develop** ideas and **propose an** expert system offering solutions to the challenging problems of Artificial Intelligence.
CO5	**Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in a collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.

Course Contents:

Module 1: Introduction to PROLOG Programming along with the IDE and its Basic Components

Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy. Understanding facts, rules, queries, and syntax.

Module 2: Recursive definitions in Prolog

Fibonacci Series, Calculator, Factorial, summation, list length, etc. Using recursive rules.

Module 3: Defining facts and simple queries

Writing a knowledge base for family relationships, basic objects.

Module 4: **Rules and inference in Prolog**

Creating logical rules and testing inferences.

Module 5: List operations in Prolog

Checking membership, concatenation, reverse, max/min of list.

Module 6: Pattern matching and symbolic reasoning

Simple examples involving pattern recognition (e.g., shape or name matching, Family Tree design)

Module 7: Expert system simulation (Mini project)

Building a mini knowledge-based system (e.g., Animal Classification, Medical diagnosis, etc).

Textbook:

Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley.

CO–PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	-	2
CO5	2	2	3	3	2	2	2	2	2	2	2	2	2	3

Course Name: ENGINEERING CHEMISTRY LAB
Paper Code: CH 291
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2

Course Objective

- **Study the basic principles of pH meter and conductivity meter for different**
- **applications**
- **Analysis of water for its various parameters & its significance in industries**
- **Learn to synthesis Polymeric materials and drugs**
- **Study the various reactions in homogeneous and heterogeneous medium**

Course Outcome

CO1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2: Able to analyse and determine the composition and physical property of liquid and solid samples when working as an individual and also as a team member
CO3: Able to analyse different parameters of water considering environmental issues
CO4: Able to synthesize drug and sustainable polymer materials.
CO5: Capable to design innovative experiments applying the fundamentals of modern chemistry

COURSE CONTENT

Any 10 experiments to be conducted preferably a combination of estimation, water quality analysis, instrumental analysis and synthesis

1. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution.
2. Estimation of amount of Fe^{2+} in Mohr's salt using permanganometry.
3. To determine the surface tension of a given liquid at room temperature using stalagmometer by drop number method.
4. To determine the viscosity of a given unknown liquid with respect to water at room temperature, byOstwald's Viscometer.
5. Water quality analysis :
    i. Determination of total, permanent and temporary hardness of sample water by complexometric titration.
    ii. Determination of Cl^- ion of the sample water by Argentometric method
    iii. Determination of alkalinity of the sample water.
    iv. Determination of dissolved oxygen present in a given water sample.
6. Determination of the concentration of the electrolyte through pH measurement.

pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.

Determination of cell constant and conductance of solutions.

Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.

Determination of Partition Coefficient of acetic acid between two immiscible liquids.

Drug design and synthesis

Synthesis of polymers (Bakelite) for electrical devices and PCBs.

Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.

Determination of R_F of any amino acid by thin layer chromatography.

Saponification /acid value of any oil.

Isolation of graphene from dead dry batteries

IDEA Lab Workshop

Course Code	**:**	**ME 293**
Course Title	**:**	**IDEA Lab Workshop**
Number of Credits	**:**	**(L: 0, T: 0, P: 3)**
Credit	**:**	**1.5**

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project

Course Contents *:*

Module	Topics	
1	Electronic component familiarisation, Understanding electronic system design flow. Schematic design and PCB layout and Gerber creation using EagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.	Introduction to basic hand tools - Tape measure, combination square, Vernier calliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,

2	Familiarisation and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.	Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.
3	Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging	3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab
4	Discussion and implementation of a mini project.	
5	Documentation of the mini project (Report and video).	

Laboratory Activities:

S. No.	List of Lab activities and experiments
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testi of the circuit.
2.	Machining of 3D geometry on soft material such as soft wood or modelling w
3.	3D scanning of computer mouse geometry surface. 3D printing of scann geometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3 or 6 m thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.
8.	Embedded programming using Arduino and/or Raspberry Pi.
9.	Design and implementation of a capstone project involving embedded hardwa software and machined or 3D printed enclosure.

Reference Books:

S. No.	Title
1.	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing, New Delhi.
2.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
3.	Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.

5.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
9.	Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945,978-9352131952, 978-9352133703
11.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
12.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
13.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.
14.	Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978- 1484200773
15.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

Course Title: Digital Logic and Computer Organization Lab
Course Code: CS293
Contact Hours: 3:0:0
Total Contact Hours: 36
Credits: 1.5

Course Objectives

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

- To provide hands-on experience in designing and analyzing combinational and sequential logic circuits.
- To enhance understanding of digital systems using simulation and HDL tools.
- To familiarize students with arithmetic circuits, memory design, and basic CPU control logic through practical implementation.

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

CO1	Implement and verify the functionality of basic and derived logic gates, using ICs and simulation tools to demonstrate fundamental digital operations.
CO2	Design and simplify combinational logic circuits from Boolean expressions using Karnaugh Maps, and simulate them for correctness and efficiency.
CO3	Construct and analyze sequential circuits such as flip-flops, counters, and shift registers to demonstrate state behavior and timing sequences.
CO4	Develop arithmetic circuits and evaluate algorithmic performance (e.g., Booth's multiplication) using Hardware Description Languages (HDL).
CO5	Integrate combinational and sequential modules to create a simplified CPU architecture through collaborative mini-projects, enhancing teamwork, communication, and project management skills.

CO-PO Mapping:

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

Course Content

Lab No.	Title	Description
1	Basic Logic Gates	Implement and verify truth tables of NOT, AND, OR, NAND, NOR, XOR, XNOR gates using ICs and simulation software.
2	Boolean Expression Simplification	Design logic circuits from Boolean expressions, simplify using Karnaugh Maps, and simulate the simplified circuit.
3	Combinational Circuit – Adders &Subtractors	Implement Half-Adder, Full-Adder, Half-Subtractor, and Full-Subtractor using logic gates and ICs.
4	Design of Code Converters	Design and implement Binary to Gray, Gray to Binary, Binary to BCD, and BCD to Excess-3 converters.
5	Multiplexers and Demultiplexers	Design and verify 4:1, 8:1 MUX and 1:4, 1:8 DEMUX using logic gates and ICs or simulation tools.

6	Encoders and Decoders	Implement 8-to-3 encoder and 3-to-8 decoder using logic gates and analyze their truth tables.
7	Flip-Flops and Latches	Design and test SR, JK, D, T flip-flops using ICs or HDL; study race-around and master-slave configurations.
8	Synchronous and Asynchronous Counters	Design and simulate up/down counters (binary, mod-n, ring, Johnson) and study their timing behavior.
9	Shift Registers	Implement SISO, SIPO, PIPO, and PISO registers using flip-flops or HDL; demonstrate serial and parallel operations.
10	Arithmetic Circuits Using HDL	Model addition, subtraction, Booth's multiplication, restoring and non-restoring division using Verilog/VHDL.
11	Memory and Address Decoding	Simulate basic RAM/ROM using HDL and design address decoder circuits for memory mapping.
12	Mini Project / CPU Module Simulation	Group-based implementation of a simple CPU datapath (ALU + Register File + Control Unit) using HDL or simulation.

Tools and Resources:

Software: Logisim, Multisim, ModelSim, Xilinx Vivado / ISE, Quartus
Hardware Kits: Digital Trainer Kit, ICs (74xx series), LEDs, switches, Breadboards
Languages: Verilog/VHDL (optional for advanced simulation)

Textbooks:

3. Digital Logic and Computer Design by M. Morris Mano,Pearson Education, 1st Edition
4. Computer Organization and Architecture: Designing for Performance by William Stallings,Pearson Education, 10th Edition

Reference Books:

6. Digital Design by M. Morris Mano, Michael D. Ciletti, Pearson Education, 5th Edition
7. Computer Organization and Embedded SystemsByCarl Hamacher, ZvonkoVranesic, SafwatZaky,McGraw-Hill Education, 6th Edition
8. Computer Organization and Design: The Hardware/Software InterfaceBy David A. Patterson, John L. Hennessy, Morgan Kaufmann Publishers, RISC-V Edition
9. Fundamentals of Logic Design by Charles H. Roth Jr., Larry L. Kinney,Cengage Learning, 7th Edition
10. Digital Fundamentals by*Thomas L. Floyd,* Pearson Education, 11th Edition

R25 (B.Tech. CST)

Curriculum & Syllabus for B. Tech Under Autonomy

Incorporation of NEP 2020

2nd Year 3rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CT301	Operating System	3	0	0	3	3
2	ENGG	Major	CT302	Design and Analysis of Algorithms	3	0	0	3	3
3	SCI	Minor	M(CT)301	Discrete Mathematics	3	0	0	3	3
4	ENGG	Minor	EC(CT)301	Digital Logic and Electronics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	CT391	Operating System Lab	0	0	3	3	1.5
2	ENGG	Major	CT392	Design and Analysis of Algorithms Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(CT)391	Digital Logic and Electronics Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	CT393	IT Workshop Lab (SciLab/MATLAB/C++/ Python)	0	1	3	4	2.5
Total of Theory & Practical								25	19

Course Name: Operating System
Course Code: CT301
Contact Hours/Week: 3
Total Contact Hours: 36L
Credit: 3

Prerequisites:
1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):
After Successful completion of the course, students will be able to

CO1	Understand the fundamental concepts of Operating System, Protection & Security and differentiate different types of Operating System.
CO2	Understand and implement process & thread; understand, apply, compare different process synchronization algorithm and inter process communication to solve engineering problems
CO3	Understand/explain/analyze different synchronization techniques, critical section problems and deadlock and apply them to solve engineering problems.
CO4	Understand/explain different memory management techniques including virtual memory management; also able to apply, compare, and implement different page replacement algorithms to solve engineering problems.
CO5	Understand/explain different I/O mechanisms, File structures and disk management techniques and solving engineering problems applying different disk scheduling algorithms.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module – 1: [4L]
Computer System Architecture **[1L],** Introduction to Popular Operating Systems, Functionalities of Operating System, Evolution of Operating System [**1L**];
Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security. [**1L**]
System Calls: What are System Calls, Types of System Calls, System Programs [**1L**]

Module – 2: [5L]
Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, Inter-process communication: Message passing. [**2L**]
Threads: overview, benefits of threads, user and kernel level threads, Thread models, Thread Scheduling **[1L]**
CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling). **[2L]**

Module – 3: [11L]
Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors. **[6L]**
Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock. **[5L]**

Module 4: [6L]
Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB. [**3L**]
Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [**3L**]

Module 5: [8L]
Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK etc), disk reliability, disk formatting, boot block, bad blocks. [**2L**]
File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector), Directory Structure [**2L**]
I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [**1L**]
Protection and security: Illustrations of security model of UNIX and other OSs [**1L**]. Examples of attacks [**1L**]

Module 6: [2L] Operating Systems in Industry & Embedded Systems: An Introduction, Types of Popular OS in Industry [**1L**], Linux: Definition, Types, Ubuntu: Introduction & Usage. [**1L**]

Text Book:
1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.
2. Operating Systems & Systems Programming by P Balakrishna Prasad

Reference Book:
1. Dietel H. N., ―An Introduction to Operating Systems‖, Addison Wesley.
2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
3. William Stallings, Operating Systems, Prentice Hall

Course Name: Design & Analysis of Algorithm
Course Code: CT302
Contact Hours/Week: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

1. To know data-structure and basic programming ability
2. To know algorithmic thinking & complexity analysis Ability

Course Outcomes (COs):

After attending the course, students should be able to

CO1	To understand and illustrate the concepts of time and space complexity, worst case, average case and best-case complexities and the asymptotic notation.
CO2	To analyze and apply the design principles and concepts to various basic algorithm design viz. dynamic programming, greedy methods etc.
CO3	To understand and analyze various string matching and graph algorithms.
CO4	To understand, illustrate and analyze the different complexity classes
CO5	To discuss, implement and analyze, verify the efficiency of the randomized and approximation algorithms.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module-1 [4L]
Algorithm Development & Complexity Analysis: [4L] Stages of algorithm development for solving a problem: Describing the problem, identifying a suitable technique, Design of an algorithm, Proof of Correctness of the algorithm. Time and Space Complexity, Different Asymptotic notations –their mathematical significance. Solving Recurrences: Substitution Method, Recurrence Tree Method, Master Theorem (Statement Only).

Module-2 [15L]
Algorithm Design Techniques: Brute force techniques – Traveling Salesman Problem, Divide and Conquer - Matrix multiplication: Strassen‘s algorithm, Greedy techniques - Fractional Knapsack problem, Job Sequencing with Deadline, Graph Coloring, Finding Minimum Cost Spanning Tree, Bin Packing Algorithm, Dynamic programming -O/1 Knapsack problem, Matrix chain multiplication, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module-3 [5L]
Graph Algorithms Single Source Shortest Path – Dijkstra ‘s Algorithm, All pair shortest path – Floyd- Warshall Algorithm. Network Flows, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.

Module-4 [6L]
Complexity Classes: The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.

Module-5 [6L]
Approximation and Randomized Algorithms [4L], Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum. Recent Trends [2L]

Reference Book:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and RobertoTamassia, Wiley.
5. Analysis and Design of Algorithms: A Beginner's Approach, Rajesh K. Shukla.

Course Name: Discrete Mathematics

Course Code: M(CT)301

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Higher Secondary Level Mathematics

Course Outcome(s):

After completion of the course students will be able to

CO1	Understand the fundamental concepts of Set Theory to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Mathematical Logic and Proof Techniques so that they can Prove theorems using Proof Techniques and Mathematical Logic Frameworks to justify a claim.
CO3	Explain or illustrate the fundamental Theory of Numbers and Identify problems where students can Use the concept appropriately to Solve them.
CO4	Explain or illustrate the fundamental principles of Algebraic Structures and Identify problems where students can Apply the concept appropriately to Solve them.
CO5	Develop ideas to Propose solutions to the problems of Graph Theory and Identify problems where students can Apply the concept appropriately and analyze the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

Course Content:

Module -1: Set Theory [8L]Set: Operations and Properties of set, Finite Set, Power Set, Cardinality of finite set, Cartesian Product, Relation: Types of Relations, Properties of Binary Relation, Equivalence Relation, Partial Ordering Relation and Poset, Lattice.[4L] Combinatorics and Counting: Sum and product rule, Permutation and Combination Principle of Inclusion

Exclusion. Pigeon Hole Principle.[2L] Generating Functions and Recurrence Relations: Recursively defined relation and functions, Discrete Numeric Function, Growth of Functions, Problems on Recurrence Relations and their solutions using different methods.[2L]

Module-2:

Mathematical Logic and Proof Techniques [8L] Propositional Logic: Basics of Boolean Logic, Idea of Propositional Logic, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Inference theory of Propositional Logic.[3L] Predicate Logic: Idea of First Order Predicate Logic and Quantifiers, well-formed formula of predicate, Inference theory of Predicate Logic.[3L] Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.[2L].

Module-3:

Theory of Numbers [4L] Well-Ordering Principle, Divisibility theory and properties of Divisibility, Fundamental theorem of Arithmetic, Prime and Composite Numbers. [2L] Greatest Common Divisor and Euclidean Algorithm, Congruence, Residue Classes. [2L]

Module-4:

Algebraic Structures [8L] Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms.[5L] Elementary properties of Rings and related problems[1L] Elementary properties of Fields and related problems. [1L] Elementary properties of Vector Space and related problems. [1L]

Module-5:

Graph Theory [8L] Graph Terminologies and their properties: Degree, Connectivity, Path, Cycle, Sub-Graph, Isomorphism, Eulerian and Hamiltonian Walks, Matrix representation of graphs, Shortest Path in Graph. [2L] Graph Colouring and Matching: Colouring Vertices and Chromatic Number, Colouring Edges and Total Colouring, Independence and Chromatic Partitioning, Cliques, Perfect Graphs, Bounds on Chromatic Numbers, Chromatic Polynomials, Matching.[3L] Tree: Rooted Trees, Binary Search Tree and Tree Sorting, Spanning Tree, Weighted Trees and prefix codes. [3L]

Textbook:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill.

2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.

Reference Books:

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.

2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and Its Application to Computer Science‖,

TMG Edition, Tata McGraw-Hill

3. Seymour Lipschutz, Marc Lipson, Discrete Mathematics (Schaum‘s Outlines Series), Tata McGraw - Hill.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Digital Logic and Electronics

Course Code: EC(CT)301

Contact: 3:0:0

Credit: 3

Total Contact Hours: 36

Pre-requisite:

Basic concepts of Logic gates, Truth Tables, Concept of basic components of a digital computer.

Course Outcome(s):

CO1	To realize basic gate operations and laws Boolean algebra.
CO2	To understand basic mechanism of digital computers and digital logic behind different arithmetic and control unit operations.
CO3	To design combinational circuits and combinational functions for larger more complex circuits.
CO4	To perform different operations with sequential circuits.
CO5	To understand fundamental concepts and techniques used in Logic families and PLDs

.

Course Content: –

Module – 1: [8L]

Binary Number System [1L]; BCD, ASCII, EBDIC, Gray codes and their conversions [1L], Introduction and laws of Boolean algebra [1L], Boolean functions, Minterm and maxterm, Prime implicants, Representation in SOP and POS forms[2L], Minimization of logic expressions by Karnaugh Map and algebraic method [3L]

Module – 2: [8L]

Combinational circuits:

Adder and Subtractor (half-full adder & subtractor) [2L], Serial & Parallel Adder, Carry look ahead adder and

Parity Generator[2L], Encoder, Decoder, Multiplexer [2L], Demultiplexer, Comparator, Code Converters [2L]

Module – 3: [12L]

Sequential Circuits:

Flip-Flops, SR, JK, Master slave JK, D, T, characteristic Tables, Excitation tables [5L]. Basic concept of Synchronous and Asynchronous counters, Up/Down Counters, Ring counter, Johnson counter, Design of Modulo-N Counter, Counter applications [5L]. Registers (SISO, SIPO, PIPO, PISO) [2L].

Module – 4:[8L]

A/D and D/A conversion techniques – Basic concepts (D/A:R-2-R only [2L], A/D: successive approximation [2L])Logic families- TTL, ECL, MOS and CMOS - basic concepts [2L],Programmable logic Array, programmable Array logic, Sequential Programmable Devices [2L].

Text Book:

1. Saliva Hanan S, Digital Circuits and Design, Oxford

2. Morries Mano- Digital Logic Design- PHI

Reference Book:

1. R.P.Jain—Modern Digital Electronics, 2/e, Mc Graw Hill

2. Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson

CO-PO Mapping:

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

Course Name: Operating System Lab
Course Code: CT391
Contact: 0:0:3
Total Contact Hours: 36 L
Credit: 1.5

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes (COs):

After attending the course students should be able to

CO1	Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF,and Priority.
CO2	Understand the concepts of deadlock in operating systems.
CO3	Implement them in Multiprogramming system.
CO4	Create process creation and implement inter process communication
CO5	Analyze the performance of the various page replacement schemes

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module 1:

Essential Linux Commands[7P]: Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find,sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes(use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

Module 2:

Shell Programming [6P]: Creating a script, making a script executable, shell syntax (variables, conditions,control structures, functions, and commands).

Module 3:

Process [3P]: Starting new process, replacing a process image, duplicating a process image, creating programs for parent process, child process, orphan process, sleeping process, running process and zombie process. [Kalyani University]

Module 4:

Semaphore [3P]: Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).

Module 5:

POSIX Threads[5P]: Programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit,pthread_attr_init, pthread_cancel) .

Module 6:

Signal Handling [3P]: C programming for signal handling, sending signals and signal interface. [KU]

Module 7:

Shared Memory [9P]: Create the shared memory , Attach the shared memory segment to the address spaceof the calling process , Read information from the standard input and write to the shared memory, Read the content of the shared memory and write on to the standard output , Delete the shared memory

Text Books:

1. Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPB Publications
2. Beej's Guide to Unix IPC
3. W. Richard Stevens, UNIX Network Programming, 2nd edition, Prentice Hall
4. UNIX Concepts and Applications, Sumitabha Das, McGrawhill

Course Name: Design & Analysis of Algorithm Lab
Course Code: CT392
Contact: 0:0:3
Total Contact Hours: 36 L
Credits: 1.5

Prerequisites:

1. Programming knowledge.

Course Outcomes (COs):

After attending the course students should be able to

CO1	To identify and prove the correctness and analyze the running time of the basic algorithms forthose classic problems in various domains.
CO2	To understand and illustrate methods for analyzing the efficiency and correctness of algorithms (such as exchange arguments, recurrence, induction, and average case analysis)
CO3	To analyze and design algorithms using the dynamic programming, greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy.
CO4	To understand, compare, contrast, and choose appropriate implementation of the algorithmic design techniques to present an algorithm that solves a given problem.
CO5	To Identify and analyze criteria and specifications appropriate to new problems.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module 1: Implementation of various Divide & Conquer Methods; viz. Merge Sort, Quick Sort , Matrix Multiplication etc.

Module 2: Implementations of various Dynamic Programming Methods, viz. Matrix Chain Multiplication Method, Travelling Salesman Problem etc.

Module 3: Implementations of various Branch & Bound Techniques, viz BFS, 0/1 Knapsack Problem, job Sequencing with Deadlines problem.

Module 4: Implementations of various Backtracking Methods, viz. DFS , n-Queen Problem.

Module 5: Implementations of Greedy Method, viz. Fractional Knapsack Problem, Job Sequencing Problem etc.

Course Name: Digital logic and electronics Lab

Course Code: EC(CT)391

Contact: 0:0:3

Credit: 1.5

Prerequisite:

Basic concepts of Logic gates, Truth Tables, function realization –minimization of Logic expressions by K-map, Concept of basic components of a digital computer, Binary Arithmetic

Course Outcomes (COs):

After attending the course students should be able to

CO1	Knowledge of Electronic components such as Resistors, Capacitors, Diodes, Transistors measuring equipment like DC power supply, Multimeter, CRO, Signal generator, DC power supply.
CO2	Analyze the characteristics of Junction Diode, Zener Diode, BJT & FET and different types of Rectifier Circuits.
CO3	Determination of input-offset voltage, input bias current and Slew rate, Common- mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
CO4	Able to know the application of Diode, BJT & OP AMP.
CO5	Familiarization and basic knowledge of Integrated Circuits.

Course Content:

1. A) Realization of basic gates and universal gates.

   B) Realization of basic gates using universal gates.

2. Design a Half adder and Full Adder circuit using basic gates and verify its output.

3. Design a Half Subtractor and Full Subtractor circuit using basic gates and verify its output

4. Design an Adder/Subtractor composite unit.

5. Design of a Carry-Look-AheadAdder circuit.

6. Realization of a)Encoder, b)Decoder c) Multiplexer, d) De-mux, e)Comparator and their Truth Table verification.

7. Realization of RS / JK / D flip flops using logic gates.

8. Design of Shift Register using J-K / D Flip Flop.

9. Realization of Synchronous Up/Down counters.

10. Design of MOD- N Counter

11. Study of DAC

12. Study of logic families and PLDs

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	-	2
CO4	2	2	2
CO5	2	2	2

Course Name: IT Workshop Lab (Python/SciLab/MATLAB/C++)
Course Code: CT393
Contact: 0:1:3
Total Contact Hours: 48 L
Credit: 2.5

Prerequisites:

1. Computer Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course, students should be able to

CO1	Demonstrate a thorough understanding of modular programming by designing programs that require the use of programmer-defined functions.
CO2	Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.
CO3	Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction, and composition by designing and implementing classes, including the use of overloaded functions and constructors.
CO4	Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing, and debugging multiple complex programs.
CO5	Demonstrate an understanding of the differences between C and C++ in the areas of strings, pass by reference/passing pointers, and structs by designing and implementing programs that use C strings, C++

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module 1: Introduction to Python, IDE setup, data types, variables, input/output, basic operations

Module 2: Control flow: if-else, nested conditions, loops (for, while), loop control

Module 3: Strings, string functions, list creation, list slicing, list comprehension

Module 4: Tuples, dictionaries, sets – properties, methods, use cases

Module 5: Functions: user-defined, arguments, return types, recursion, lambda

Module 6: Exception handling: try-except, finally, built-in exceptions

Module 7: File handling: read, write, append, working with CSV files

Module 8: Object-Oriented Programming: class, object, constructor, inheritance

Module 9: Modules and packages, Python standard libraries, custom modules

Module 10: NumPy & Pandas: arrays, series, Data Frames, basic analysis

Module 11: Data visualization with Matplotlib: plots, charts, customization

Module 12: GUI Programming with Tkinter, PyQt5, and SQLite database connectivity

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CT401	Object Oriented Programming	3	0	0	3	3
2	ENGG	Major	CT402	Computer Networks	3	0	0	3	3
3	ENGG	Major	CT403	Database Management Systems	3	0	0	3	3
4	ENGG	Major	CT404	Programming in Python	3	0	0	3	3
5	SCI	Minor	M(CT)401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	CT491	Object Oriented Programming Lab	0	0	3	3	1.5
2	ENGG	Major	CT492	Computer Networks Lab	0	0	3	3	1.5
3	ENGG	Major	CT493	Database Management Systems Lab	0	0	3	3	1.5
4	ENGG	Minor	M(CT)491	Numerical Methods Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(CT)491	Soft Skill & Aptitude	2	0	0	2	1
Total of Theory & Practical								27	22

Course Name: Object Oriented Programming

Course Code: CT401
Contact Hours/Week: 3:0:0
Total Contact Hours: 36
Credit: 4

Prerequisites:
1. Basic understanding of Computer Programming and related Programming Paradigms Problem
2. Solving Techniques with proper logic Implementation

Course Outcomes (COs):
After attending the course, students should be able to

CO1	Design the process of interaction between Objects, classes & methods w. r. t. Object Oriented Programming.
CO2	Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.
CO3	Analyze various activities of different string handling functions with various I/O operations.
CO4	Discuss basic code reusabilityfeaturew.r.t. Inheritance, Package and Interface.
CO5	Implement Exception handling, Multithreading and Applet (Web programing) programming concept in Java.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	-	2	3
CO2	3	2	-
CO3	2	-	3
CO4	3	2	-
CO5	-	2	3

Course Content:

Module-1: Introduction [2L]
Object Oriented Analysis (OOA) & Object Oriented Design (OOD) – Concepts of object oriented programming language, Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class. [1L]; Discussion about various OOPS languages and their similarities & differences. [1L].

Module-2: Basic Programming Constructs [10L]
Basic concepts of OOPS programming - Data types, Different types of Variables. [2L]; Operators, Control statements, Loops & Arrays.[1L] ; Creation of class, object, method. [1L], Encapsulation and Class specification [1L], Member function specification, Access qualifiers, Instance creation [2L]; Constructor-Definition, Usage of Constructor, Different types of Constructor.[1L]; Method & Constructor overloading. [1L], Copy constructors, static class members and objects [1L]; this keyword, use of objects as parameter & methods returning objects.[1L], Objects as final classes, Object class [1L] [CU]; Call by value & call by reference. [1L].

Module-3: Basic String handling & I/O [6L]
Basic string handling concepts- Concept of mutable and immutable string, Methods of String class. [2L]; Methods of String buffer class. [1L]; Command line arguments, basics of I/O operations– keyboard input using Buffered Reader[1L]; Creating & Using String Objects, Manipulating Strings, String Immutability &Equality, Passing Strings To & From Methods [2L], Scanner class/Extractor/Equivalent method, Simple I/O with Byte and Character streams, Reading/Writing from console and files [2L] [CU].

Module-4: Inheritance and Packages [8L]
Inheritance - Definition, Advantages, Different types of inheritance and their implementation. [1L]; Method overriding, Dynamic method dispatch. [1L]; Abstract classes & methods.[2L]; Multiple inheritance by using Interface. [1L]; Packages - Definition, Creation of packages. [1L]; Package and Class visibility [1L]; Access Modifiers - public, private, default and protected, Importing packages, member access for packages. [1L]; Instance of operator, Casting of objects [1L]. Wrapper Classes, Enumerations and Metadata; [1L] [CU]

Module-5: Exception handling, Multithreading[6L]
Exception handling - Basics, different types of exception classes. Difference between Checked & Unchecked Exception [1L]; Try & catch related case studies, Throw keyword.[1L]; Creation of user defined exception. [1L]; Multithreading - Basics, main thread [1L]; Thread life cycle, Creation of multiple threads [1L]; Thread priorities, thread synchronization. [1L]; Inter thread communication, deadlocks for threads[1L]; Accessing and manipulating databases [1L] [CU];

Module-6: Event and GUI programming [2L]
Event handling[1L], event classifications, mouse and keyboard events, GUI basics, panels and frames, layout managers [1L], GUI components such as buttons, check boxes, radio buttons, labels, text fields, text areas, combo boxes, lists, scroll bars, sliders, windows, menus, dialog boxes[1L].

Module-7: Case studies [2L]
JavaBeans, Network Programming, Graphics, Database handling, IntelliJ, BlueJ, Visual Studio, Dev C++, C Lion.[1L].[own suggestion], OOP in AI and Data Science, Data Handling, Model Architecture and Training (Data Encapsulation, Encapsulating models as class, Encapsulating training loops)[1L], Single Responsibility Principle, Open/Closed Principle, Liskov Substitution Principle in AI programming [2L] [own suggestion]

Textbook:

1. Herbert Schildt– "Java: The Complete Reference " – 9thEd.– TMH
2. E. Balagurusamy–"Programming With Java: A Primer"–3rdEd.–TMH.
3. Bruce, Foundations of Object Oriented Languages, PHI
4. Patrick Naughton, Herbert Schildt –"Thecompletereference-Java2"–TMH
5. "Advanced Programming forJAVA2Platform" Austinand Pawlan, Pearson

Reference Books:

1. R. K Das–"Core Java for Beginners"–VIKASPUBLISHING.
2. Rumbaugh, James Michael, Blaha–"Object Oriented Modelling and Design"–Prentice Hall, India.
3. Rambaugh, James Michael, Blaha-"Object Oriented Modelling and
4. Design"-Prentice HallI ndia /Pearson Education

Course Name: Computer Networks

Course Code: CT402
Contact Hours/Week: 3
Total Contact Hours: 36
Credit: 3

Prerequisites:

1. Familiarity and knowledge of Operating Systems and Computer Architecture.
2. Also require a little bit of programming languages concepts like C, Java.

Course Outcomes (COs):

After attending the course, students should be able to

CO1	Understand basics of computer network and different architecture and topologies of computer network and analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
CO2	Understand/analyze different protocols of the data link layer and apply them to solve engineering problems.
CO3	Understand/analyze different protocols of Network and Transport Layer and apply them to solve engineering problems.
CO4	Understand/analyze different protocols of session and application layer and apply them to solve engineering problems.
CO5	Develop, Analyze, specify and design the topological and routing strategies using socket programming.

CO-PO Mapping:

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

CO-PSO Mapping:

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Content:

Module 1: Introduction [6L]

Introduction (3L):
Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network.
Physical Layer: [3L]
Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network;

Module 2: Data Link Layer [8L]

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub-layer, The Channel Allocation. [4L]
Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx, Bluetooth, RFID, Bridges, Virtual LANs, Switching. [4L].

Module 3: Network Layer [10L]

IP Addressing, IPv4and IPv6. Difference IPv4and IPv6, Conversion ofIPv4and IPv6, Subnetting, Supernetting, Design Issues, Store-and-Forward Packet Switching, Virtual-Circuit and Datagram Networks, ARP, IP, ICMP, IPV6, BOOTP and DHCP–Delivery protocols Other Protocols such as mobile IP in wireless Network. [5L]
Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing: RIP, OSPF, BGP; Routing for Mobile Hosts. [5L]

Module 4: Transport layer: [6L]

Process to Process delivery; UDP; TCP, SCTP, TCP RENO, TCP/IP in Wireless environment, Congestion control in TCP: Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm, Remote Procedure Call. [5L]
Socket Programming (UDP socket and TCP Socket) [1L]

Module 5: Application Layer [3L]

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Module 6: Modern topics and Queuing Theory[3L]

ATM, DSL technology, Introduction to Queuing Theory and Delay Analysis for networks.

Text books:

1. B. A. Forouzan – Data Communications and Networking (3rd Ed.) ––– TMH
2. S. Tanenbaum – Computer Networks (4th Ed.) – Pearson Education/PHI
3. W. Stallings – Data and Computer Communications (5th Ed.)– PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

Reference books:

1. Kurose and Rose – Computer Networking -A top-down approach featuring the internet - Pearson Education
2. Leon, Garica, Widjaja – Communication Networks – TMH
3. Walrand – Communication Networks‖ – TMH.
4. Comer – Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.) – Pearson Education/PHI

Course Name: Database Management Systems

Course Code: CT403
Contact Hours/Week: 3
Total Contact Hours: 36
Credit: 3

Prerequisites:
1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes (COs):
After attending the course, students should be able to

CO1	To understand and describe the basic concepts and utility of the Database Management System, including different data models of the Database Management System.
CO2	To design an Entity Relationship (E-R) Diagram and relational model for any kind of real-life application and be able to apply relational algebra operations, SQL, PL/SQL, No-SQL, and Neo4j for solving queries.
CO3	To analyze and create a relational database for any real-life applications based on normalization & denormalization.
CO4	To apply the query optimization techniques, different file organization techniques, and determine whether the transaction satisfies the ACID & BASE properties.
CO5	Explore DBMS-based ideas through developing software programs with adequate documentation in a collaborative environment for successfully carrying out projects on DBMS Problems and investigate their effectiveness by analyzing the performances using proper techniques and tools, and assess the limitations of solutions, underscoring utilitarian importance for further explorations leading towards lifelong learning.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	-	3	-
CO3	2	-	2
CO4	2	-	2
CO5	2	2	3

Course Content:

Module – 1: [2L] Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module – 2: [10L] Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study & problem solving on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database.

Module – 3: [4L] Functional Dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Denormalization, Case Study & Problem Solving

Module 4: [6L] Concept of DDL, DML, DCL. Basic Structure, set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using PL-SQL, bind and host variables, Anonymous Block, cursor, Stored Functions, Stored procedures, and triggers

Module 5: [4L] Physical data structures, Query optimization: join algorithm, statistics, and cost-based optimization. Transaction processing, Concurrency control, and Recovery Management: transaction model properties, state serializability, lock-based protocols; two-phase locking, Dead Lock handling.

Module 6: [4L] File & Record Concept, Fixed and Variable-sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Module 7: [4L] Introduction to No-SQL, Document-oriented databases, JSON and BSON format, working with MongoDB, data preparation and cleaning techniques, MongoDB basic operations and architecture, indexing, aggregation

Module 8: [4L] Concept of graph-based model, difference between relational model and graph-based model, application, overview of Neo4j CQL, Query solving

Text Book:

1. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
2. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, McGraw-Hill.
3. Kristina Chodorow, Michael Dirolf, “MongoDB: The Definitive Guide”, O'Reilly Media.
4. Tareq Abedrabbo, Nicki Watt, Dominic Fox, Aleksa Vukotic, “Neo4j in Action”, Manning

Reference Book:

1. Ramakrishnan: Database Management System, McGraw-Hill
2. Steven Feuerstein, “Oracle PL/SQL Best Practices, Optimizing Oracle Code”, O'Reilly Media

Course Name : Programming in Python

Course Code : CT404

Contact : 3:0:0

Total Contact Hours: 36

Credits : 3

Prerequisite:

1. Basics of computer, Boolean Algebra

Course Objective(s)

- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Indicate the use of regular expressions and built-in functions to navigate the file system.

Course Outcome(s)

On completion of the course students will be able to –

CO1	**Interpret** the fundamental Python syntax and semantics and be fluent in the **use** of Python control flow statements.
CO2	**Develop** proficiency in the handling of strings and functions
CO3	**Identify** the methods to **design** and **modify** Python programs by **applying** the data structures like lists, dictionaries, tuples and sets.
CO4	**Articulate** the concepts of Dictionaries while **analyzing** different case studies.
CO5	**Identify** the commonly used operations **collaborating** file systems and regular expressions.

Course Contents:

Module-I: Parts of Python Programming Language [6]

Parts of Python Programming Language, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, **Control Flow Statements,** The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement.

Module-II: Functions **[4]**

Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Module-III: Strings **[10]**

Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, **Lists,** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

Module-IV: Self-Study **[8]**

Dictionaries, Creating Dictionary, Accessing and Modifying key; value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, **Tuples and Sets,** Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Usingzip() Function, Sets, Set Methods, Traversing of Sets, Frozenset.

Module-V: Files **[8]**

Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python OS and os.path Modules, **Regular Expression Operations,** Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.

Text books:

1. Gowrishankar S, Veena A, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor & Francis, 2018.

Recommended books:

1. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, 1st Edition, O'Reilly Media, 2016.

2. Aurelien Geron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, 2nd Edition, O’Reilly Media, 2019.

3. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015.

4. Miguel Grinberg, “Flask Web Development: Developing Web Applications with Python”, 2nd Edition, O'Reilly Media, 2018.

CO-PO Mapping

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

Course Name: Probability and Statistics
Course Code: M(CT)401
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard algebra and calculus.

Course Outcome(s):

After completion of the course students will be able to
CO1: Recall the distinctive principles of probability and statistics.
CO2: Understand the theoretical workings of theory of probability and tests of hypotheses.
CO3: Apply statistical methods to compute and explain point estimators and interval estimators for mean, variance and proportion.
CO4: Analyze statistical data from engineering experiments.

Course Content

Module 1 (Probability and Random Variables) [15L]

The axioms of probability, Conditional probability, Bayes theorem, Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Module 2 (Two dimensional random variables) [5L]

Joint distributions, Marginal and conditional distributions, Covariance, Correlation and linear regression, Transformation of random variables, Central limit theorem (for independent and identically distributed random variables).

Module 3 (Sampling Distribution) [3L]

Distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems

Module 4 (Estimation) [4L]

Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.

Module 5 (Testing of Hypotheses) [9L]

Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi square goodness of fit test and its applications, problems.

Project Domains:

1. Construction of Univariate and Bivariate frequency tables
2. Diagrammatic and Graphical representation of data.
3. Fitting of discrete and Continuous distributions
4. Regression Analysis
5. Curve Fitting
6. Tests of significance with regard to Single Mean, Two Means
7. Construction of Confidence intervals for Mean, Variance and Proportion

Text and Reference Books:

1. Sheldon M. Ross, ―Introduction to Probability and Statistics for Engineers and Scientists‖, Academic Press, (2009).
2. D. C. Montgomery and G.C. Runger, ―Applied Statistics and Probability for Engineers‖, 5th edition, John Wiley & Sons, (2009).
3. Robert H. Shumway and David S. Stoffer, ―Time Series Analysis and Its Applications with R Examples‖, Third edition, Springer Texts in Statistics, (2006).
4. N. G. Das: Statistical Methods, TMH.
5. Sancheti, D. S. &Kapoor,V.K. : Statistics Theory, Method & Application, Sultan chand & sons, NewDelhi**,** N.K.Dutta (2004). Fundamentals of Biostatistics, Kanishka Publishers.

CO-PO Mapping:

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

Course Name: Object Oriented Programming Lab

Course Code: CT491
Contact: 0:0:3
Total Contact Hours: 36 L
Credit: 1.5

Prerequisites:

5. Basic Programming Knowledge
6. Problem-Solving and Algorithmic Thinking
7. Development Environment Setup

Course Outcomes (COs):

After attending the course students should be able to

CO1	Create the procedure of communication between Objects, classes & methods.
CO2	Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
CO3	Analyze distinct features of different string handling functions with various I/O operations.
CO4	Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
CO5	Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	-	3	3
CO2	3	2	3
CO3	-	3	3
CO4	3	3	-
CO5	-	2	3

Course Content:

Module-1: Basics[10L]

1. Simple programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming on this keyword, call by value, static variables & methods, inner classes

Module-2: Basic String handling & I/O[12L]

1. Programming to show the use of String class methods.
2. Programming to show the use of Object as Final Class, Object Class.
3. Programming to show the use of String Buffer class methods.
4. Programming on Command line arguments.
5. Programming using keyboard input.

Module-3: Inheritance, Interface and Java Packages[6L]

1. Programming on Simple Inheritance, keywords & relevant methods.
2. Programming on method overriding, dynamic method dispatch, abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user-defined package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.
4. Programming to show the use of wrapper class, enumeration and metadata.

Module-4: Exception handling and Multithreading [6L]

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.
2. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.
3. GUI Programming to display some message, creating functionality to add 2 integers.
4. Programming to show use of Multithreading.
5. Programming for showing thread life cycle, deadlock.

Module-5: Case studies [2L]

1. Introduction to IntelliJ, BlueJ, Visual Studio, Dev C++, CLion.
2. Innovative programming to demonstrate the use of OOPs in creating, training & optimizing a Neural Network to classify IRIS, MNIST datasets. [own suggestion]

Textbook:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India

Course Name: Computer Networks Lab
Course Code: CT492
Contact: 0:0:3
Total Contact Hours: 36 L
Credits: 1.5

Prerequisites:
1. Familiarity and knowledge of Computer Network and Computer Architecture
2. Also require strong knowledge of programming languages like C, Java and UNIX or Linux environment.

Course Outcomes (COs):
After attending the course students should be able to

CO1	To design and implement small size network and to understand various networking commands.
CO2	To provide the knowledge of various networking tools and their related concepts.
CO3	To understand various application layer protocols for its implementation in client/server environment
CO4	Understand the TCP/IP configuration for Windows and Linux
CO5	Learn the major software and hardware technologies used on computer networks

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Contents:

Module 1:

Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping. Internetworking , Operating Systems - Configurations. [4L]

Module 2:

Socket Programming using TCP and UDP: Socket Programming for TCP client server (Iterative server). Socket Programming for TCP client server (Concurrent Server). Socket programming for UDP client. Handling both TCP client and UDP client using select() system call. [12L]

Module 3:

Implementing routing protocols such as RIP, OSPF. [2L]

Module 4:
Implementation of CRC and Hamming code for error handling[2L]

Module 5:
Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS, Packet capturing and analyzing using packet tracer tool [4L]

Module 6:
Two player game (Tic Tac Toe) implementation. [2L]

Module 7:
Server Configuration: only web server (If time permit, Instructor can do more than that)
RPC (Remote Procedure Call) implementation. [6L]

Textbooks:

1. TCP sockets in C Programs - Practical guide for Programmers By Micheal, J Donahoo and Kenneth L Calvert.

2. Richard Stevens, Unix Network Programming, Volume 1 and 2, Addison-Wesley Professional.

3. Socket Programming by Raj Kumar Buyaa

Reference Books: 1. Neil matthew and Richard Stones, Beginning Linux Programming, Wrox Publishers, 4th Edition.

Course Name: Database Management System Lab
Course Code: CT493
Contact: 0:0:3
Total Contact Hours: 36 L
Credit: 1.5

Prerequisites:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcomes (COs):

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

CO1	Demonstrate and explain the database management system and different database languages.
CO2	Understand and apply the SQL queries related to the management of data and transaction processing for solving real-life problems.
CO3	Explain and analyze about query processing techniques involved in query optimization.
CO4	Demonstrate and apply the SQL, PL/SQL, No-SQL programming, the concept of Cursor Management, Error Handling, Package, and Triggers for solving real-life complex problems.
CO5	Design and assess the commercial database systems.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	3
CO3	2	3	2
CO4	3	3	3
CO5	3	3	3

Course Content:

Module 1: Conceptual Design using ER Diagrams (Identifying entities, attributes, keys, and relationships between entities, cardinalities, generalization, specialization, etc.), Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, represent attributes as columns, identifying keys) and apply the normalization techniques.

Module 2: Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables, and Dropping Tables, Practicing DML commands- Insert, Select, Update, Delete

Module 3: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS, etc., Practicing Sub queries (Nested, Correlated) and Joins (Equi, Inner, Outer, Natural, Cross, Self), Relational Algebra Operations (Selection, Projection, Union, Intersect*, Minus*, Cross/Cartesian), SQL Standard Syntax for Joins, copying table structure/data, Sequences (AUTO_INCREMENT), indexing, Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS, Creation and Dropping

Module 4: Declaring PL-SQL variables, bind and host variables, simple and complex anonymous block, explicit and implicit cursor implementation, Opening Cursor, Fetching the data, closing the cursor, Stored Procedures, Execution, calling of Procedure, and Modification of Procedure, PL/SQL, Error Handling and Exceptions, Types of Handler Actions, How to write Handler, Defining and handling exceptions in Stored Procedures and Functions, Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, updating using trigger, creating packages, calling a package

Module 5: Introduction to MongoDB, Features of MongoDB, MongoDB command interface and MongoDB

compass, Mongo Chef, MongoDB Documents & Collections, RDBMS & MongoDB analogies: relations/tables => collections; tuples/records => documents, JSON and BSON documents, Using MongoDB Shell and Compass, creating a database, connecting to a database, Creating Collections, indexing, aggregation, performing crud (create, read, update, delete) operations, upsert

Module 6: Introduction to the Neo4j ecosystem and installation, Overview of Neo4j Desktop and Browser interface, Sample graph: Movie database exploration, Nodes, relationships, properties, and labels, designing a simple graph data model, creating graph models using Neo4j Bloom or visual tools, creating nodes and relationships using CREATE, reading data using MATCH and RETURN, updating nodes/relationships with SET, Deleting with DELETE and DETACH DELETE, Filtering with WHERE clause, Working with patterns and variables, Use of OPTIONAL MATCH and WITH, Creating and using indexes, Overview of Neo4j Graph Data Science (GDS) library

Textbooks

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2020). Database system concepts (7th ed.). McGraw-Hill Education.
2. Elmasri, R., & Navathe, S. B. (2017). Fundamentals of database systems (7th ed.). Pearson Education.

Reference Books

1. Coronel, C., & Morris, S. (2019). Database systems: Design, implementation, & management (13th ed.). Cengage Learning.
2. Connolly, T., & Begg, C. (2015). Database systems: A practical approach to design, implementation, and management (6th ed.). Pearson Education.

Course Name: Numerical Methods Lab
Course Code: M(CT)491
Allotted Hours: 30L

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Outcomes (COs):

After attending the course students should be able to

CO1	Describe and explain the theoretical workings of numerical techniques with the help of C
CO2	Compute basic command and scripts in a mathematical programming language
CO3	Apply the programming skills to solve the problems using multiple numerical approaches.
CO4	Analyze if the results are reasonable, and then interpret and clearly communicate the
CO5	Apply the distinctive principles of numerical analysis and the associated error measures.

Course Content:

1. Assignments on Newton forward /backward, Lagrange‘s interpolation.

2. Assignments on numerical integration using Trapezoidal rule, Simpson‘s 1/3 rule, Weddle‘s rule.

3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. LU Factorization method.

4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method

5. Assignments on ordinary differential equation: Euler‘s method, Euler‘s modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

   Implementation of numerical methods on computer through C/C++ and commercial Software Packages:Matlab/ Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group) / Python.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Paper Name: Soft Skill and Aptitude Training

Paper Code: HU(CT)491

Contact: 0:0:2

Total Contact Hours: 24

Credit: 1

Course Objective: To train the students in acquiring workplace-specific interpersonal communication skills.

Course Outcome: By the end of the course the students will be enabled

CO1: to identify, define, apply workplace interpersonal communication modalities in an effective manner.

CO2: to employ, infer, relate group behavioral and personal interview skills.

CO3: to organize, differentiate, employ reading proficiency skills.

CO4: to identify, classify, organize and relate question types and aptitude test patterns in placement tests.

Course Content:

Module 1 – Introduction to Soft Skills

1.The Skills of Interpersonal Communication. 2. Team Behavior. 3. Time Management Skills

Module 2- Verbal Ability: Reading

Enhancing reading speed and vocabulary enhancement through intensive practice of placement test-based reading passages.

Module 3 – Verbal Ability Test Patterns

Introducing Verbal Ability tests—Test Question Types: Synonyms and Antonyms, Error Spotting/Sentence Improvement, Analogies and Para Jumbles.

Module 4 – Group Discussion and Personal Interview

Basics of Group Discussion—Intensive practice on answering interview-based questions common in placement interviews.

CO-PO Mapping

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

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT501	Advanced Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	CT502	Web Technology	3	0	0	3	3
3	ENGG	Major	CT503	Software Engineering	3	0	0	4	3
4	ENGG	Major	CT504A	Computer Graphics	3	0	0	3	3
			CT504B	Network Security and Cryptography					
			CT504C	Theory of Computation					
5	HUM	Minor	HU(CT)501	Project Management and Finance	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	CT591	Advanced Artificial Intelligence Lab	0	0	3	3	1.5
2	ENGG	Major	CT592	Web Technology Lab	0	0	3	3	1.5
3	ENGG	Major	CT593	Software Engineering Lab	0	0	3	3	1.5
4		Internship	CT581	Internship/Industrial Training	0	0	2	2	2
5	PRJ	Project	CT582	Project -I	0	0	0	4	2
Total of Theory & Practical								30	22.5

SYLLABUS	
Semester – 5th	
Course Name	**Advanced Artificial Intelligence**
Course Code	**CT501**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objectives of this course are to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcome:

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

CO1	**Understand and explain** the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Frame work or an Inferencing Model/Agent Design Frame work within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.
CO5	**Implement** Inferencing Models of Artificial Intelligence through **developing** feasibl algorithms and **investigate** their effectiveness by **analyzing** their performances in solving th relevant problems.

CO-PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	3	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	2	-	-	-	-	-	-	-	2	-	2
CO4	2	2	2	3	-	-	-	-	-	-	2	2	-	2
CO5	2	2	3	3	2			-	-	-	2	2	2	3

MODULE NUMBER	COURSE CONTENT
1	**Introduction to Artificial Intelligence [1L]** Basic Concepts, History of Artificial Intelligence, Architecture of an Artificial Intelligent Agent, Applications of Artificial Intelligence
2	**Artificial Intelligence Problem Formulation as State-Space Exploration Problem for Goal Searching [5L]** Basic Concepts, State-Space Exploration Formulation for Water Jug Problem, Missionarie and Cannibals Problems, Farmer-Wolf-Goat-Cabbage Problem, 8-Puzzle Problem, Constrain Satisfaction Problem and Production System for Goal Searching. Blind Search Techniques for Goal Searching: Breadth First Search, Depth First Search, Dept Limited Search, Iterative Deepening Search, Uniform Cost Search, Bi-directional Search.
3	**Heuristic Techniques for Goal Searching [8L]** Basic Concepts of Heuristic Techniques and Properties of Heuristic Functions, Hill Climbing Search. Best First Search, A* Search, Memory-bounded heuristic search: Iterative-deepening A* Search, Recursive Best First Search, Simplified Memory Bounded A* Search. Simulated Annealing Based Stochastic Search, Genetic Algorithm Based Evolutionary Search, Ant Colony Optimization, Particle Swarm Optimization.
4	**Adversarial Search for Game Playing [2L]** Basic Concepts, Minimax Search, Alpha-Beta Pruning.
5	**Knowledge Representation and Inference using Propositional Logic and Predicate Logic[5L]** Propositional Logic: Knowledge Representation and Inference using Propositional Logic Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

6	**Slot-and-Filler Structure for Knowledge Representation [2L]** Weak Slot-and-Filler Structure for Knowledge Representation: Semantic Nets and Frames. Strong Slot-and-Filler Structure for Knowledge Representation: Conceptual Dependency and Script.
7	**Reasoning under Uncertainty [5L]** Bayesian Inferencing and Bayesian Belief Network, Dempster-Shafer Theory, Overview of Fuzzy Logic and Inferencing, Overview of Hidden Markov Model
8	**Planning [5L]** Basic Concepts, Problem of Blocks World, Components of a Planning System, Algorithms fo Planning: Goal Stack, Nonlinear Planning Using Constraint Posting, Hierarchical Planning Algorithms for Planning as State-Space Search, Heuristics for planning, Planning Graphs and GRAPHPLAN Algorithm.
9	**Introduction to Natural Language Processing [1L]** Basic Concepts, Steps of Natural Language Processing, Morphological, Syntactic and Semantic Analysis, Discourse Integration and Pragmatic Analysis, Applications of Natural Language Processing.
10	**Introduction to Machine Learning [2L]** Basic concepts of Machine Learning Model, Supervised Learning, Unsupervised Learning, and Reinforced Learning, Overview of Artificial Neural Network

Textbook:

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
2. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill.

SYLLABUS	
Semester – 5th	
Course Name	**Web Technology**
Course Code	**CT502**
Lecture (per week)	**3**
Tutorial (per week)	**3**
Contact Hours (per week)	**0**
Total Contact Hours	**36**
Credit	**3**

Course Objective(s):

1. To impart the design, development, and implementation of Static and Dynamic Web Pages.
2. To develop programs for Web using Scripting Languages and .net framework.
3. To give an overview of Server Side Programming in Web.

Course Outcomes:

After completion of the course students will be able to:

CO1	**Understand** networks, IP, DNS, routing and other related technologies used in internet and **execute** and **solve** problems related to them leading to engineering problems solutions
CO2	**Understand** different web based technologies like HTML, DHTML, CSS, XML and demonstrate their use in design of web based solutions leading to engineering problems
CO3	**Comprehend** and analyze different client and server side technologies like JavaScript, Servlet, CGI and design appropriate engineering solutions leading to lifelong learning
CO4	**Understand and implement** different types of technologies like JSP, JavaBean, JDBC and ODBC and evaluate their performances
CO5	**Understand** different web based applications and network security techniques and apply them to protect the network against different attacks and solve related problems preferably as a team

CO-PO & PSO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**[6L]** Introduction (1L): Overview, Network of Networks, Intranet, Extranet, and Internet. World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control Congestion control, IP Datagram, IPv4 and IPv6. IP Sub netting and addressing (1L): Classful and Classless Addressing, sub netting. NAT, IP masquerading, IP tables. Internet Routing Protocol (1L): Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing Broadcast. Electronic Mail (1L): POP3, SMTP, Clients - Servers Communication.
2	**[9L]** HTML, DHTML & CSS: Introduction, Elements, Attributes, Heading, Paragraph. Formatting[1L]; Link, Table, List, Block, Layout, Html Forms, and input [1L]; Iframe, Colors[1L], Image Maps and attributes of image area [1L]; Introduction to CSS, basic syntax and structure of CSS, different types internal, external and inline CSS [1L]; Basic Introduction of DHTML, Difference between HTML and DHTML, Documentary Object Model (DOM) [1L]. Extended Markup Language (XML) : Introduction, Difference between HTML & XML,XML-Tree [1L]; Syntax, Elements, Attributes, Validation and parsing, DTD [2L].
3	**[15L]** Java Scripts: Basic Introduction, Statements, comments, variable, operators, data types [1L]; condition, switch, loop, break [1L]; Java script functions, objects, and events[1L]. CGI Scripts: Introduction, Environment Variable, GET and POST Methods [1L]. Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request, Response, Get and post [1L]; Cookies and Session [1L]. Java Server Page (JSP): JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSP Script-let Tag [1L]; JSP implicit object (request and response) [1L]; Variable declaration, methods in JSP [1L]; JSP directive (Taglib and Include), JavaBean- inserting JavaBean in JSP [1L]; JSP Action tags (Forward & Include) [1L]; Creating ODBC data source name, Introduction to JDBC, prepared statement and callable statement [1L].
4	**[6L]** Threats[1L]: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing modification, denial of service attacks. Network security techniques: Password and Authentication; VPN, IP Security [1L], security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH)[1L]. Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy. Search Engine and Web Crawler: Definition, Meta data, Web Crawler [1L], Indexing, Page rank, overview of SEO[1L].

Textbooks:

1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)
2. "Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication. (Topics covered: Java Script)
3. "Head First Servlet's & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)
4. Cryptography and Network Security by William Stallings Publisher: Pearson Education India(Topics covered: Threats, Security techniques, Firewall)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.

2. “Core Web Programming”- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001

SYLLABUS	
Semester – 5th	
Course Name	**Software Engineering**
Course Code	**CT503**
Lecture [per week]	**3**
Tutorial [per week]	**0**
Contact Hours [per week]	**3**
Total Contact Hours	**36**
Credit	**3**

Pre-requisites:

Programming for Problem Solving

Course Objective[s]

1. To understand the working environment in industry and aware of cultural diversity, who conduct themselves ethically and professionally.
2. Graduates use effective communication skills and technical skills to assure production of quality software, on time and within budget.
3. Graduates build upon and adapt knowledge of science, mathematics, and engineering to take on more expansive tasks that require an increased level of self-reliance, technical expertise, and leadership.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concept of Software Engineering and mathematical knowledge and **apply** them in designing solution to engineering problem including he specification, **design**, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
CO2	**Analyze, elicit and specify** software requirements through a productive working relationship with various stakeholders of the project
CO3	**Design** applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
CO4	**Develop** the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.
CO5	**Identify** and **Use** modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction[6L]** Software Engineering, Characteristics, Components, Application, Definitions. Software Project Planning-Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation : COCOMO[Basic, intermediate, Complete] model.
2	**Software life cycle models[6L]** Evolution and impact of Software engineering, software life cycle models Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non- functional requirements, Requirements gathering, Requirements analysis and specification.
3	**Software design[8L]** Basic issues in software design, modularity, cohesion, coupling and layering, function- oriented software design: DFD and Structure chart, object modeling using UML, Object- oriented software development, user interface design. Coding standards and Code review techniques.
4	**Software Testing[7L]** Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.
5	**Software project management[9L]** Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.

2. Software Engineering-Pankaj Jalote [Wiley-India]

Reference Books:

1. Software Engineering –Agarwaland Agarwal[PHI]

2. Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, [2009].

3. Software Engineering: A Practitioner?s Approach", by Roger S. Pressman, McGraw -Hill.[2005]

SYLLABUS	
Semester – 5th	
Course Code	**CT504A**
Course Name	**Computer Graphics**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Mathematics, Computer Fundamentals & Principle of Computer Programming

Course Objectives:

1. The objectives of this course are to enable students to use of the component of graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. Understand the basic principles of 2Dand 3Dcomputer graphics.
3. Understand of how to scan convert the basic geometrical primitives, how to transform the shapes to fit the master the picture definition.
4. Understand the mapping from a world co-ordinates to device co-ordinates, clipping, and projections.
5. Discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Course Outcome:

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

CO1	**Understand t**he fundamental concept of Computer graphics and mathematical knowledge and explain the foundations of computer graphics and different display technology and devices.
CO2	**Demonstrate** different scan conversion algorithms, drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms, clipping algorithms, surface removal algorithms using graphics tools.
CO3	**Understand** the basic concept of graphics programming and implementclippingwiththecomprehensionofwindows,view-portsinrelationtoimages display on screen.
CO4	**Analyze** and compare different drawing algorithms, polygon filling algorithms, curves and surface drawing algorithms hidden surface illumination methods
CO5	**Develop** the concept of geometric models, mathematical and algorithmic approach necessary for programming computer graphics leading to lifelong learning.

CO-PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction [4L]** Introduction: Objective, applications, GKS/PHIGS, normalized co-ordinate system, aspect ratio.
2	**Computer Graphics System [4L]** Graphics System: Vector and raster graphics, various graphics display devices, graphics interactive devices, segmented graphics, attribute table.
3	**Computer Graphics System [4L]** Raster Scan Graphics: Line drawing algorithms, circle/ellipse drawing algorithms, polygon filling algorithms.
4	**Geometric Transformation [4L]** Geometric Transformation: Homogeneous co-ordinate system, 2D and 3D transformations, projection— orthographic and perspective.
5	**Curves and Surfaces [4L]** Curves and Surfaces: Curve approximation and interpolation, Lagrange, Hermite, Bezier and B Spline curves/surfaces and their properties, curves and surface drawing algorithms.
6	**Curves and Surfaces 2 [4L]** Geometric modeling: 3D object representation and its criteria, edge/vertex list, constructive solid geometry, wire-frame model, generalized cylinder, finite element methods.
7	**Viewing and Clipping [4L]** Clipping: Window and viewport, 2D and 3D clipping algorithms.

8	**Hidden Surfaces [4L]** Hidden Lines and Hidden Surfaces: Concept of object- and image-space methods, lines and surface removal algorithms.

9	**Illumination and Color models [4L]** Intensify, Coloring and Rendering: RGB, YIQ, HLS and HSV models and their conversions, gamma correction, half toning. Illumination models, polygon mesh shading, transparency, shadow, texture.

Textbook:

1. D. Hearn and P. M. Baker: Computer Graphics, 2nd ed. Prentice Hall of India, New Delhi, 1997.
2. W. M. Newman and R. F. Sproull: Principles of Interactive Computer Graphics, McGraw Hill, New Delhi, 1979.

Reference Books:

1. F. S. Hill: Computer Graphics, McMillan, New York, 1990.
2. D. P. Mukherjee: Fundamentals of Computer Graphics and Multimedia, Prentice Hall of India, New Delhi, 1999.
3. J. D. Foley et al.: Computer Graphics, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
4. W. K. Giloi: Interactive Computer Graphics: Data Structure, Algorithms, Languages, Prentice Hall, Englewood

SYLLABUS	
Semester – 5th	
Course Name	**Network Security and Cryptography**
Course Code	**CT504B**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Computer Fundamentals & knowledge in mathematics Course Objectives:

1. The objective of this course is to teach the concepts of securing computer network protocols, based on the application of cryptography techniques.
2. Basic of cryptography, including conventional and public-key cryptography, hash functions, authentication, and digital signatures.
3. Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure.
4. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.
5. Malicious Software: Viruses, Worms, System Corruption, Attack Agents, Information Theft Key loggers, Phishing, Spyware Payload Stealthing, Backdoors, Rootkits, Distributed Denial of Service Attacks.
6. Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control.
7. IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange (IKE).

CO1	**Understand** the fundamental concept of Network security and explain the foundations of cryptography.
CO2	**Demonstrate** the use of basic solutions using cryptography, including conventional and public- key cryptography, hash functions, authentication, and digital signatures.
CO3	**Understand** the basic concept of Symmetric Key Distribution, Distribution of Public Keys, Public-Key Infrastructure.
CO4	**Analyze** remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.
CO5	**Develop** IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange (IKE).

CO-PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Module I [6]:** Security Concepts: Introduction, The need for security, Security approaches Principles o security, Types of Security attacks, Security services, Security Mechanisms, A model fo Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks
2	**Module II [8]:** Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles o public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.
3	**Module III [8]:** Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA 512), Message authentication codes: Authentication requirements, HMAC, CMAC Digital signatures, Elgamal Digital Signature Scheme. Key Management an Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure
4	**Module IV [8]:** Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

5	**Module V [6]:** E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

Textbook:

1. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN13:9780133354690.

Reference Books:

1. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
2. Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696.
3. Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141-1.
4. Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN- 10: 1284031675, ISBN-13: 978-1284031676.
5. The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.

SYLLABUS	
Semester – 5th	
Course Name	**Theory of Computation**
Course Code	**CT504C**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Digital Logic, Computer organization, Computer Fundamentals

Course Objectives:

1. The objectives of this course are to enable students to use of the component of graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. Understand the basic principles of 2Dand 3Dcomputer graphics.
3. Understand of how to scan convert the basic geometrical primitives, how to transform the shapes to fit the master the picture definition.
4. Understand the mapping from a world coordinate system to device coordinates, clipping, and projections.
5. Discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Course Outcome:

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

CO1	Understand the fundamental concepts of Finite State Automata to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	Understand the fundamental concepts of Regular Expressions and its relation with DFA so that they can Develop regular expression for a specified language and Validate it.
CO3	Understand the fundamental concepts of Context Free Grammar so that they can Design grammar for a specified language and Validate it.
CO4	Explain or Illustrate the fundamental operating principles of Push Down Automata and use it appropriately to Solve problems.
CO5	Understand the operating principles of Turing Machine and Design Turing Machines to Propose solutions to the related problems appropriately and validate the effectiveness as well as limitations of computations making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

CO-PO Mapping

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

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

MODULE NUMBER	COURSE CONTENT
1	**Module I [9L]** Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram, [1L] Introduction to Finite State Model (FSM), Design of sequence detector, Finite State Machine, Finite Automata, Deterministic Finite Automation (DFA) and Non-deterministic Finite Automation (NFA), Transition diagrams, Transition tables and Language recognizers. [3L] NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion. [2L] Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill-NerodeTheorem [2L] Limitations of FSM, Application of Finite Automata[1L]
2	**Module II [7L]** Finite Automata with output − Moore & Mealy machine. Representation of Moore & Mealy Machine, Processing of the String through Moore & Mealy Machine, Equivalence of Moore & Mealy Machine – Inter- conversion. [2L] Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy Machine[1L] Minimization of incompletely specified machine−Merger Graph, Merger Table, Compatibility Graph [2L] Lossless and Lossy Machine – Testing Table, Testing Graph [2L]
3	**Module III [5L]** Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden‘s Theorem statement and proof[1L] Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA[2L] Constructing Regular Expression for a given Finite Automata[1L] Pumping Lemma of Regular Sets. Closure properties of regular sets[1L]
4	**Module IV [9L]** Grammar Formalism-Context Free Grammars, Derivation trees, sentential forms. Rightmost andleftmost derivation of strings, Parse Tree, Ambiguity in context free grammars. [1L] Minimization of Context Free Grammars. [1L], Removal of null and unit production[1L]Chomsky normal form and Greibach normal form. [1L] Pumping Lemma for Context Free Languages. [1L] Enumeration of properties of CFL, Closure property of CFL, Ogden‘s lemma & its applications [1L], Regular grammars−right linear and left linear grammars[1L] Pushdown Automata: Pushdown automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA[1L] Acceptance of CFL, Acceptance by final state and acceptance by empty state and itsequivalence. [1L] Equivalence of CFL and PDA, inter-conversion. [1L]
5	**Module-5 [5L]** Turing Machine: Turing Machine, definition, model**[1L]** Design of TM, Computable functions **[1L],** Church ‘s hypothesis, counter machine **[1L]** Types of Turing machines **[1L]** Universal Turing Machine, Halting problem**[1L]**

Textbook:

1. Introduction to Automata Theory Languages and Computation‖, Hopcroft.E. and Ullman J.D., Pearson Education.

Reference Books:

1. Formal Languages and Automata Theory‖,C. K. Nagpal, Oxford
2. ―Switching and Finite Automata Theory‖, Zvi Kohavi, 2nd Edition, Tata McGraw Hill

SYLLABUS	
Semester – 5th	
Course Name	**Project Management and Finance**
Course Code	**HU(CT)501**
Lecture [per week]	**2**
Tutorial [per week]	**0**
Contact Hours [per week]	**2**
Total Contact Hours	**24**
Credit	**2**

Course Objectives

1. To introduce students to the fundamental concepts and components of Project Management.
2. To develop the ability to perform preliminary project screening and appraisal, enabling students to identify viable project opportunities and assess their potential.
3. To provide knowledge and analytical skills for conducting comprehensive feasibility studies.
4. To impart foundational knowledge of Financial Management principles.
5. To enhance decision-making abilities related to financial management, particularly in areas such as investment analysis, cost control, and project financing.

Course Outcome[s]:

On completion of the course students will be able to

CO1	Understand and explain the fundamental principles, tools, and techniques of project management including planning, scheduling, monitoring, and control in engineering projects.
CO2	Apply project screening and feasibility analysis methods to assess the technical, market, and operational viability of engineering projects.
CO3	Analyze financial data to evaluate project investments, including concepts such as time value of money, break-even analysis, and risk-return trade-off.
CO4	Demonstrate decision-making capabilities in project financing and resource allocation, using basic financial management principles and tools.

MODULE NUMBER	COURSE CONTENT
1	**BASICS OF PROJECT MANAGEMENT:** BASICS OF PROJECT MANAGEMENT: Meaning, Definition and scope and Need for Project Management - The Project Life Cycle - Phases of Project Management Life Cycle - Project Management Processes. (2L)
2	**PROJECT IDENTIFICATION AND SELECTION:** Preliminary Screening of Projects. Project Identification Process- Sources of Financial resources - Pre-Feasibility Study - Feasibility Studies: Market Feasibility, Financial Feasibility and Technical Feasibility (3L)

3	**PROJECT ORGANIZATION AND PLANNING:** Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis– PV ratio.
4	**PROJECT SCHEDULING AND RESOURCE MANAGEMENT:** Inflation-Meaning of inflation, types, causes, measures to control inflation. National Income- Definition, Concepts of national income, Method of measuring national income.
5	**NATURE AND SCOPE OF FINANCIAL MANAGEMENT** Concepts and Definition of Accounting, Journal, Ledger, Trial Balance. Trading A/C, Profit & amp; Loss A/C and Balance Sheet.
6	**BALANCE SHEET AND PROFIT AND LOSS STATEMENTS** Time value of money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence. Evaluation of engineering projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
7	**PROFIT RELATIONSHIPS** Break even analysis, ratio analysis, of operating and financial leverages, Working Capital Management, Credit Policy. (3L) Financial Decision Making: Sources of raising capital, Internal financing, Cost of capital, Balanced Capital Structure. Capital Structure Theories, Dividend Policy & its Theories. (5L)

Textbooks:

1. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India
2. Principles of Economics, Deviga Vengedasalam; Karunagaran Madhavan, Oxford University Press.

Reference Books:

1. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. PatricKoelling, Pearson
2. R.Paneer Seelvan, “ Engineering Economics”, PHI
3. Ahuja, H.L., “Principles of Micro Economics”, S.Chand & Company Ltd
4. Jhingan, M.L., “Macro Economic Theory”
5. Macro Economics by S.P.Gupta, TMH
6. Haniff and Mukherjee, Modern Accounting,Vol-1,TMG
7. Modern Economic Theory – K.K. Dewett [S.Chand]

Reference Books:

1. Engineering Economy by William G. Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson

2. R. Paneer Seelvan, " Engineering Economics", PHI

3. Ahuja, H. L., "Principles of Micro Economics" , S. Chand & Company Ltd

4. Jhingan, M.L., "Macro Economic Theory"

5. Macro Economics by S. P. Gupta, TMH

6. Haniff and Mukherjee, Modern Accouning,Vol-1,TMG

7. Modern Economic Theory – K.K. Dewett [S.Chand]

SYLLABUS	
Semester – 5th	
Course Name	**Advanced Artificial Intelligence Lab**
Course Code	**CT591**
Lecture (per week)	**0**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites: Data Structure, Design and Analysis of Algorithms, Statistics

Course Objectives:

The objectives of this course are to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Frame work of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies

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

CO1	**Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** it utilitarian importance in current technological context leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	**Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	**Develop** ideas and **propose** expert systems offering solutions to the challenging problems of Artificial Intelligence.
CO5	**Plan and Implement** Artificial Intelligence base did eas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in collaborative environment for successfully carrying ou projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction to PROLOG Programming along with the IDE and its Basic Components** Assignments for understanding the Basic Components of Knowledge Representation and inferencing in Artificial Intelligence using PROLOG Programming and its working strategy.
2	**Arithmetic, Boolean Expression, Decision Making Strategies** Assignments for understanding implementation of Arithmetic Expression, Boolean Expression, and Decision-Making Strategies.
3	**Recursion and Looping through Recursion** Assignments for understanding implementation of Recursion and Looping through Recursion.
4	**List of Data Items in PROLOG** Assignments for understanding the utility of List in solving various problems.
5	**Blind Search Techniques – BFS, DFS** Implementation of BFS and DFS Algorithms for Goal Searching to solve Puzzles (8-Puzzle, Water Jug Puzzle)
6	**Heuristic Search Techniques – A* Search** Implementation of A* Search Algorithm for Goal Searching to solve Puzzles (8-Puzzle, Route Finding Puzzle)
7	**Constraint Satisfaction Problem Solving** Implementation of Backtracking Strategies to solve Constraint Satisfaction Problems (Graph Coloring Problem, 8-Queens Problem)

8	**Game Playing** Implementation of Adversarial Search Algorithm with alpha-beta pruning strategy for Game Playing (Tic-Tac-Toe)
9	**Discussion on Project Problems and Allocation (Problem Description Report Submission)**
10	**Designing Solution Model and Proposal Report Submission**
11	**Project Implementation, Verification and Documentation**
12	**Project Demonstration and Project Report Review**

Textbook:

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley
2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.
3. Rich, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGrawHill.

Reference Books:

1. Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill.

SYLLABUS	
Semester – 5th	
Course Name	**Web Technology Lab**
Course Code	**CT592**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Course Objective(s):

1. To impart the design, development, and implementation of Static and Dynamic Web Pages.
2. To develop programs for Web using Scripting Languages and .net framework.
3. To give an overview of Server Side Programming in Web.

Course Outcomes:

After completion of the course students will be able to:

CO1	**Understand** networks, IP, DNS, routing and other related technologies used in internet and e**xecute** and **solve** problems related to them leading to engineering problems solutions
CO2	**Understand** different web based technologies like HTML, DHTML, CSS, XML and **demonstrate** their use in design of web based solutions leading to engineering problems
CO3	**Comprehend** and **analyze** different client and server side technologies like JavaScript, Servlet, CGI and **design** appropriate engineering solutions leading to life long learning
CO4	**Understand** and **implement** different types of technologies like JSP, Java Bean, JDBC and ODBC and **evaluate** their performances
CO5	**Understand** different web based applications and network security techniques and **apply** them to protect the network against different attacks and **solve** related problems preferably as a team

CO-PO & PSO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**[6L]** Introduction (1L): Overview, Network of Networks, Intranet, Extranet, and Internet. World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6.IP Subnetting and addressing (1L): Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables. Internet Routing Protocol (1L): Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail (1L): POP3, SMTP, Clients - Servers Communication.
2	**[9L]** HTML, DHTML &CSS: Introduction, Elements, Attributes, Heading, Paragraph. Formatting[1L]; Link, Table, List, Block, Layout, Html Forms, and input [1L]; Iframe, Colors[1L], Image Maps and attributes of image area [1L];Introduction to CSS, basic syntax and structure of CSS, different types internal, external and inline CSS [1L];Basic Introduction of DHTML, Difference between HTML and DHTML, Documentary Object Model (DOM) [1L].Extended Markup Language (XML) : Introduction, Difference between HTML & XML,XML-Tree [1L]; Syntax, Elements, Attributes, Validation and parsing, DTD [2L].
3	**[15L]** Java Scripts: Basic Introduction, Statements, comments, variable, operators, data types[1L]; condition, switch, loop, break [1L]; Java script functions, objects, and events[1L].CGI Scripts: Introduction, Environment Variable, GET and POST Methods[1L].Java Servlet: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request, Response, Get and post [1L]; Cookies and Session [1L]. Java Server Page (JSP): JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSPScriptlet Tag [1L]; JSP implicit object (request and response) [1L]; Variable declaration, methods in JSP [1L]; JSP directive (Taglib and Include), JavaBean- inserting JavaBean in JSP [1L]; JSP Action tags (Forward & Include) [1L]; Creating ODBC data source name, Introduction to JDBC, prepared statement and callable statement [1L].
4	**[6L]** Threats[1L]: Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques: Password and Authentication; VPN, IP Security[1L], security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH)[1L].Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy. Search Engine and Web Crawler: Definition, Meta data, Web Crawler [1L], Indexing, Page rank, overview of SEO[1L].

Textbooks:

"Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)

"Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication. (Topics covered:Java Script)

"Head First Servlet's & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)

Cryptography and Network Security by William Stallings Publisher: Pearson Education India(Topics covered: Threats, Security techniques, Firewall)

Recommended books:

. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.

. "Core Web Programming"- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001

SYLLABUS	
Semester – 5th	
Course Name	**Software Engineering Lab**
Course Code	**CT593**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Pre-requisites:
Programming for Problem Solving

Course Objective(s)

1. To learn software development skill through various stages of software life cycle.
2. To ensure the quality of software through software development with various protocol based environment.
3. Graduates build upon and adapt knowledge of science, mathematics, and engineering to take on more expansive tasks that require an increased level of self-reliance, technical expertise, and leadership.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concept of Software Engineering and mathematical knowledge and **apply** them in designing solution to engineering problem including he specification, **design**, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
CO2	**Analyze**, elicit and specify software requirements through a productive working relationship with various stakeholders of the project
CO3	**Design** applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
CO4	**Develop** the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.
CO5	**Identify** and **Use** modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	Introduction[6P] Preparation of requirement document for standard application problems in standard format. (e.g. Library Management System, Railway Reservation system, Hospital management System, University Admission system) .DFD of standard application problems.
2	Software life cycle models [6P] Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age, Productivity, Cost etc.) Estimation of project size using Function Point (FP) for calculation.
3	Software design [6P] Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose.(For standard application problems)
4	Software Coding& Testing[9P] Software Development, Coding Practice and Debugging, Design Test Script/Test Plan(both Black box and White Box approach)
5	Software project management[9P] Software project management, Project planning and control, configuration control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations using standard tools.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.

2. Software Engineering-Pankaj Jalote (Wiley-India)

Reference Books:

1. Software Engineering–Agarwal and Agarwal(PHI)

2. Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).

3. Software Engineering: A Practitioner‟s Approach”, by Roger S. Pressman, McGraw-Hill.(2005)

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	CT601	Deep Learning Techniques	3	0	0	3	3
2	ENGG	Major	CT602	Machine Learning	3	1	0	4	4
3	ENGG	Major	CT603	Digital image processing	3	0	0	3	3
4	ENGG	Major	CT604A	Cloud Computing	3	0	0	3	3
			CT604B	Mobile Computing					
			CT604C	Natural Language Processing					
5	HUM	Minor	HU(CT)601	Cyber Law and Ethics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	CT691	Deep Learning Techniques Lab	0	0	3	3	1.5
2	ENGG	Major	CT692	Machine Learning Lab	0	0	3	3	1.5
3	ENGG	Major	CT693	Digital image processing Lab	0	0	3	3	1.5
4	PRJ	Project	CT681	Project-II	0	0	12	12	6
Total of Theory & Practical								25	26.5

SYLLABUS	
Semester – 6th	
Course Name	**Deep Learning Techniques**
Course Code	**CT601**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Knowledge of Linear Algebra, DSP, PDE will be helpful

Course Objectives:

The objectives of this course are to enable students to

1. This course gives and understanding of the theoretical basis underlying neural networks and deep learning.
2. Furthermore, the course includes implementation of neural components and as well as applying deep learning on real-world data sets using modern deep learning packages.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Outcome:

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

CO1	**Understand** the main fundamentals that drive Deep Learning.
CO2	**Understand** the key features in a neural network's architecture.
CO3	**Understand and acquire** the knowledge of applying Deep Learning techniques to solve various real life problems.
CO4	**Be able to build, train** and **apply** fully connected deep neural networks.
CO5	Develop Inferencing Models for proposing solutions to the problems of neural network's architecture.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction to Neural Network**:[**8L]** Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network. Back Propagation Learning, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.
2	**Learning Models**:[**6L]** Unsupervised Learning with Deep Network, Autoencoders, Convolutional Neural Network, Building blocks of CNN, Transfer Learning.
3	**Introduction to Deep Learning: [4L]** Bayesian Learning, Decision Surfaces, Linear Classifiers, Linear Machines with Hinge Loss
4	**Learning Models**:[**8L]** Revisiting Gradient Descent, Momentum Optimizer, RMS Prop, Adam, Classical Supervised Tasks with Deep Learning, Image Denoising, Semanticd Segmentation, Object Detection etc. LSTM Networks.
5	**Optimization Problem [10L]** Optimization Techniques, Gradient Descent, Batch Optimization, Generative Modeling with DL,Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Textbook:

1. "Neural Networks, Fuzzy logic, and Genetic Algorithms", S. Rajasekaran& G. A. V. Pai , PHI.

Reference Books:

1. Deep Learning- Ian Goodfelllow, Yoshua Benjio, Aaron Courville, The MIT Press
2. Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

SYLLABUS	
Semester – 6th	
Course Name	**Machine Learning**
Course Code	**CT602**
Lecture [per week]	**3**
Tutorial [per week]	**1**
Contact Hours [per week]	**4**
Total Contact Hours	**48**
Credit	**4**

Pre-requisites:

Data Structure, Design and Analysis of Algorithms, Statistics, Artificial Intelligence

Course Objectives:

1. Comprehend the fundamental concepts of the evolving technologies in machine learning such as Supervised and Unsupervised Learning
2. Formulate an engineering problem within the scope of machine learning paradigm.
3. Apply the concepts of machine learning to solve problems of making automated decisions dealing with large scale data.
4. Develop and Implement ideas for proposing solutions to the challenging problems of machine learning
5. Analyze the effectiveness of various machine learning Frameworks.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concepts of machine learning to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of regression analysis so that they can propose models for predicting values based on exemplary data and Analyze their performances.
CO3	**Explain or Illustrate** the fundamental strategies of unsupervised machine learning paradigm to solve clustering problems and **Analyze** their performances.
CO4	**Explain or Illustrate** the concepts of Mining Frequent Patterns, Associations and Data Streams and Apply them to solve the relevant problems and **Analyse** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of supervised learning and **Identify** problems where students can **Apply** the concept appropriately and **Analyze** the effectiveness as well as limitations of solutions making the students aware of its utilitarian importance for further explorations leading towards lifelong learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction to Machine Learning[7L]** Basic Concepts, Various types of Machine Learning Techniques and related applications, Issues in Machine Learning Strategies, Data Exploration for Machine Learning: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measures; Data Pre-processing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization.
2	**Classification and Regression[16L]** Basic Concepts, assessing and visualizing performance of classification, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier; Ensemble Classification, Random Forest Strategy, Linear and Nonlinear Regression Methods and their performance analysis.
3	**Clustering, Association and Outlier Analysis[12L]** Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on Connected Regions with High Density; Outlier Analysis.
4	**Mining Frequent Patterns, Associations and Data Streams[6L]** Basic Concepts, Association analysis and Frequent Item set Mining Methods: The Apriori Algorithm, Mining Time Series Data.

5	**Advanced Concepts[7L]** Introduction to advanced concepts of machine learning like Support Vector Machines and Artificial Neural Network and their applications in solving machine learning problems.

Textbook:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
2. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018
3. Machine Learning by Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson.

Reference Books:

1. Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley
2. Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow, Aurélien Géron, O'Reilly
3. Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.

Semester – 6th	
Course Name	**Digital Image Processing**
Course Code	**CT 603**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites: Design and Analysis of Algorithms, UG Level Mathematics

Course Objectives:

1. Understand the basic concepts of digital image processing and identify problems where students can apply the concept appropriately.
2. Understand the fundamental concepts of image enhancement strategies and identify the scope of enhancement where students can apply the appropriate strategy and analyze the performance.
3. Illustrate the fundamental image restoration strategiesandapply them appropriately to eliminate noise in the image.
4. Illustratevarious Image Compression Techniques and Analyze their performances.
5. Understand the ideas of Morphological Image Processing and Image Segmentation to propose solutions to the related problems and analyze the effectiveness as well as limitations of solutions underscoring its utilitarian importance for further explorations leading towards lifelong learning.

Course Outcomes: After completion of the course students will be able to	
CO1	**Understand** the basic concepts of digital image processing to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand** the fundamental concepts of image enhancement strategies and **Identify** the scope of enhancement where students can **Apply** the appropriate strategy and **Analyze**the performance.
CO3	**Illustrate** the fundamental image restoration strategies and **Apply** them appropriately to eliminate noise in the image.
CO4	**Illustrate** various Image Compression Techniques and **Apply** them to compress the images and Analyze their performances.
CO5	**Understand and Develop** ideas to Propose solutions to the problems o Morphological Image Processing and Image Segmentation and Analyze the effectiveness as well as limitations of solutions under scoring its utilitarian importance for further explorations leading towards lifelong learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	**Introduction to Digital Image Processing [3L]** Applications of digital image processing, fundamental steps in digital image processing, component of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, Some Basic Relationships Between Pixels- Neighbors and Connectivit of pixels in image, Color Image Models.
2	**Image Enhancement [10L]** Image Enhancement in The Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters. Image Enhancement in Frequency Domain: Introduction, Fourier Transform, Discrete Fourier Transform (DFT) and its relation with image characterization, fundamental steps of image enhancement in Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.
3	**Image Restoration [5L]** Basics of Image restoration and Noise characterization, Estimating the degradation function, Noise removal using spatial and frequency domain filtering, Image Restoration techniques.
4	**Morphological Image Processing [5L]** Basic Concepts, Erosion, Dilation, Opening, Closing, Skeletonization, Hole filling, Connected components, Boundary Detection.
5	**Image Compression [5L]**

	Basic Concepts – Types of redundancy, Types of coding techniques, Lossless Compression: Run Length Encoding, Huffman Coding, Lossy Compression: Vector Quantization, Sequential DCT based Compression (JPEG Baseline Algorithm).
6	**Image Segmentation [8L]** Detection of Points, lines and Edges (Sobel and Canny); Edge Linking, Image Thresholding (Otsu's method), Region based segmentation, color-feature based segmentation in color images.

Textbook:

1. Digital Image Processing, Rafael C. Gonzales, Richard E. Woods, Third Edition, Pearson Education, 2010.
2. Digital Image Processing, S. Sridhar, Oxford University Press, 2nd Ed, 2016.

Reference Books:

1. Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
2. Image Processing, analysis and Machine Vision, Milan Sonka, Thomson Press India Ltd, Fourth Edition.

SYLLABUS	
Semester – 6th	
Course Name	**Cloud Computing**
Course Code	**CT604A**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Pre-requisite:

1. The student must have basic knowledge in Computer Network and Distributed System

Course Objectives(s):

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.
3. Understand the importance of protocols and standards in computing

Course Outcome(s)

After competition of the course the student able to do

CO1	Identify the appropriate cloud services for a given application
CO2	Assess the comparative advantages and disadvantages of Virtualization technology
CO3	Analyze authentication, confidentiality and privacy issues in cloud computing
CO4	Identify security implications in cloud computing.
CO5	Understand the importance of protocols and standards in management for cloud services.

CO-PO mapping

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

MODULE NUMBER	COURSE CONTENT

1.	**Definition of Cloud Computing and its Basics [8L]** Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing [3]

	Cloud Architecture: Cloud Infrastructure, Architecture of each components, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing. [2] Services and Applications by Type [3] IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos. PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)
2.	Use of Platforms in Cloud Computing [6L] Concepts of Abstraction and Virtualization [2L] Virtualization technologies: Types of virtualization, Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern- Based Environment, Transactional-Based Environment Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2L] Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance Concepts of Platform as a Service [2L] Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development. Use of PaaS Application frameworks.
3.	Cloud Service Models [6L] Use of Google Web Services [2L] Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service. Use of Amazon Web Services [2L]

	Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service Use of Microsoft Cloud Services [2L] Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services
4.	Cloud Infrastructure [10L] Types of services required in implementation – Consulting, Configuration, Customization and Support Cloud Management [3L] An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle) Live Migration of Virtual Machines: [2L] Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration. Concepts of Cloud Security [3L] Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management. Auditing and Compliance in Cloud Environment: [2L] Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.
5.	Concepts of Services and Applications [6L] Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [6] Applications in the Cloud: Concepts of cloud transactions, functionality mapping,

	Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2] Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1] Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Text Book

1. Kai Hwang, Geoffrey C Fox, Jack J Dongarra: Distributed and Cloud Computing – From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers – 2012.
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Edition.

Reference books

3. Anthony Velte, tobyVelte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata McGraw-Hill Edition.
4. Alex Amies, Harm Sluiman, QiangGuo Tong and Guo Ning Liu: Developing and Hosting Applications on the cloud, IBM Press, 2012.
5. George Reese: Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice), O'Reilly Publications, 2009
6. Haley Beard: Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008
7. Michael Miller: Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Pearson Education, 2009.
8. Richard N. Katz: The Tower and The Cloud, Higher Education in the Age of Cloud Computing, 2008.

SYLLABUS	
Semester – 6th	
Course Name	**Mobile Computing**
Course Code	**CT604B**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisite:

1. Basic concept of computer network and communication engineering
2. Basic programming knowledge

Course Objective(s)

The objective of the course is to make the students able to –

1. Understand and illustrate the basic concepts and principles in mobile computing
2. Understand and demonstrate the various routing algorithms for both infrastructures based and ad hoc networks.
3. Identify and develop mobility and bandwidth management in cellular network
4. Design and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
5. Predict and explain the technical issues related to recent mobile computing environment

Course Outcome(s)

After completion of the course students will be able to

CO1	**Illustrate** the concepts and working of modern communication technologies.
CO2	**Demonstrate** the various routing algorithms for both infrastructure based and ad hoc networks.
CO3	**Develop** mobility and bandwidth management in cellular network
CO4	**Design** and build an energy efficient and secure mobile computing environment using heterogeneous wireless technologies
CO5	**Predict** the technical issues related to recent mobile computing environment.

CO-PO Mapping

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

MODULE NUMBER	COURSE CONTENT
1.	**Introduction [6L]** Evolution of different types of wireless communication devices; Effects of mobility of devices; Cellular mobile networks – mobility management (call setup, handoff, interoperability and internetworking), bandwidth management, energy management, security; Brief introduction about different generations of wireless communication technology – 1G, 2G, 3G, 4G, 5G.
2.	**Mobile Data Communication [5L]** Mobile Data Communication, WLANs (Wireless LANs) IEEE 802.11 standard, Bluetooth technology, Bluetooth Protocols, Ad hoc networks initialization, leader election, location identification, communication protocols, energy and security.
3.	**Mobility Management in Cellular Networks [4L]** Call setup in PLMN (location update, paging), GPRS, Call setup in mobile IP networks Handoff management; Mobility models- random walk, random waypoint, Brownian, map based, group-based.
4.	**Bandwidth Management in Cellular Mobile networks [3L]** Mathematical formulation of the channel assignment problem (CAP); CAP and generalized graph coloring; Benchmark instances; Lower bound on bandwidth, Genetic algorithms for channel assignment- concept of critical block in a hexagonal cellular network, coalesced CAP, fast near-minimal channel assignment algorithm.
5.	**Localization of Nodes in a Mobile Network [4L]** Different approaches, Indoor and outdoor localizations, LOS and NLOS signals, Outdoo localization techniques – triangulation (TOA-based, AOA- based), errors due to inaccuracie in coordinates of beacon nodes and in measurements, selection of beacon nodes; Location region identification- computational geometric technique.
6.	**Message Communication in Ad Hoc Networks [6L]** Collision avoidance mechanism (different schemes for a deterministic transmission schedule collision resolution mechanism – successive partitioning approach; Time slot assignment based on location information, Point-to-point routing in ad hoc networks – proactive, reactive and hybrid approaches, different protocols - DSDV, DSR, AODV, TORA, ZRP
7.	**Energy-efficient Communication [3L]** Energy efficiency at various layers - Physical layer, MAC layer, Network layer, Application layer, performance analysis in noisy channel environment.
8.	**Secure Wireless Communication [4L]** Introduction-different types of attacks, internal attacks, external attacks; measures against attacks (authentication, intrusion detection, encryption); RC4 algorithm, Lightweight cryptographic algorithms; anti jamming techniques.

Text books:

1) K. Sinha, S.Ghosh and B. P. Sinha, Wireless Networks and Mobile Computing. CRC Press: New York, 2015.

2) J. Schiller, Mobile Communication, Pearson

3) Yi-Bing Lin &ImrichChlamtac, Wireless and Mobile Networks Architectures, John Wiley & Sons, 2001

4) Raj Pandya, Mobile and Personal Communication systems and services, Prentice Hall of India, 2001

5) 5. XiangYang Li, Wireless Adhoc and Sensor Networks, Cambridge University Press.

Recommended books:

1) Research articles published on secure wireless communication (authentication, mitigation of DoS, DDoS, eavesdropping) published in leading journals.

2) Mark Ciampa, Guide to Designing and Implementing wireless LANs, Thomson learning, Vikas Publishing House, 2001.

3) P. Stavronlakis, Third Generation Mobile Telecommunication systems, Springer Publishers.

SYLLABUS	
Semester – 6th	
Course Name	**Natural Language Processing**
Course Code	**CT604C**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**
Prerequisites: Statistics, Automata, Compiler Design	

Objective of the course:

1. To learn the basics and details of NLP algorithms, principles & application, different NLP techniques and different tools and their uses.
2. To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
3. To learn the fundamental strategies of Language Modelling and Word Sense Disambiguation acquiring enough knowledge to Propose models for Word Prediction & Disambiguation.
4. To learn the concepts of Markov Model for POS Tagging and Probabilistic Context Free Grammars and Probabilistic parsing.
5. To learn the techniques of Syntax & Semantics Analysis for Machine Translation and Identify problems where students can Apply the concept appropriately.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic concepts of NLP to Explain or Illustrate and Identify problems where students can Apply the concept appropriately to Solve them.
CO2	**Understand** the fundamental concepts of Text Pre-processing and Morphology so that they can Apply the concept to Analyze their CORPUS.
CO3	**Explain or Illustrate** the fundamental strategies of Language Modelling and Word Sense Disambiguation acquiring enough knowledge to **Propose** models for Word Prediction & Disambiguation and **Evaluate** their performances.
CO4	**Explain or Illustrate** the concepts of Markov Model for POS Tagging and Probabilistic Context Free Grammars and Probabilistic parsing so that they can **Apply** them to solve the relevant problems and **Analyze** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of Syntax & Semantics Analysis for Machine Translation and Identify problems where students can Apply the concept appropriately and Analyze the effectiveness as well as limitations of solutions underscoring the utilitarian importance for further exploration of NLP issues leading towards lifelong learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1.	**Introduction to NLP [4L]** Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficu Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structur Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cros entropy.
2.	**Text Pre-processing and Morphology [5L]** Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.
3.	**Language Modeling [4L]** Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discountin Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of languag models.
4.	**Word Sense Disambiguation [5L]** Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, Anin formation theoretic approach, Dictionary-Based Disambiguation: Disambiguation based onsense Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.
5.	**Markov Model and POS Tagging [5L]** Markov Model: Hidden Markov model, Fundamentals, Probability of properties Parameterestimation, Variants, Multiple input observation. The Information Sources in Tagging Markovmodel taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications o Tagging.

6.	**Probabilistic Context Free Grammars and Probabilistic parsing [5L]** The Probability of a String, Problems with the Inside-Outside Algorithm, Parsing fo disambiguation, Treebanks, Parsing models vs. language models, Phrase structure grammars and dependency, Lexicalized models using derivational histories, Dependency- based models.
7.	**Syntax & Semantics Analysis and Machine Translation [8L]** Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexica Semantics, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignmen and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Socia network analysis.

Textbook:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.
4. Ela Kumar, "Natural Language Processing', Wiley

Reference Books:

1. Allen, James. 1995. – "Natural Language Understanding". Benjamin/Cummings, 2ed. 2.
2. Bharathi, A., Vineet Chaitanya and Rajeev Sangal. 1995. Natural Language Processing- "A Paninian Perspective". Prentice Hll India, Eastern Economy Edition.
3. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019

YLLABUS	
Semester – 6th	
Course Name	**Cyber Law and Ethics**
Course Code	**HU(CT)601**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisite:

1. Familiarity in computer Networking.
2. Basic concepts about network security.

Course Objective(s) :

1. To understand, explore and acquire a critical understanding of Cyber Law.
2. To learn the basics of a Cyber security

Course Outcome(s):

After completion of the course students will be able to

CO1	To understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
CO2	To acquire in depth knowledge of information technology act, security policies, and legal framework of right to privacy, data security and data protection
CO3	Todevelop the understanding of relationship between commerce and cyberspace
CO4	To be familiar with network security threats and countermeasures
CO5	To develop competencies for dealing with frauds and deceptions (Confidence Tricks, Scams

CO-PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1.	**Introduction of Cybercrime** [7L] Cybercrime, Forgery, Hacking, Software Piracy, Computer Network intrusion Jurisdiction to prescribe/Legislative Jurisdiction; Jurisdiction to adjudicate to enforce; Cyber Jurisdiction in Civil, Criminal & International Cases. Criminals plan attacks, passive attack, Active attacks, cyber stalking.
2.	**Cybercrime Mobile & Wireless devices**[8] Security challenges in mobile devices, cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.
3.	**Tools and Methods used in Cyber-crime[7L]** Proxy servers, Password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: Buffer over flowAttacks, Scripts Kiddies and Packaged Defense.
4.	**Cybercrime & Cyber security[4L]** Phising methods, ID Theft; Online identity method Legal aspects, Indian laws, IT act, Public key certificate, Design of Cyber Security Policy of an Organization ,Unicritral Model Law.
5.	**Cyber Ethics[5L]** The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethic Issues in AI and core Principles, Introduction to Block chain Ethics.

Text Books:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)

Recommended Books:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance:
Threat Analysis and Response Solutions", IGI Global, 2009.
2. Jonathan Rosenoer, "Cyber law: the Law of the Internet", Springerverlag, 1997
3. SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003) .

SYLLABUS	
Semester – 6th	
Course Name	**Deep Learning Techniques Lab**
Course Code	**CT691**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Pre-requisites:

1. Basics of probability theory, linear algebra and calculus at university level.
2. Programming skills (Python will be used throughout the course).

Course Objectives:

The objective of the course is to make the students able to -

1. Understand generic machine learning terminology
2. Understand motivation and functioning of the most common types of deep neural networks
3. Understand the choices and limitations of a model for a given setting
4. Apply deep learning techniques to practical problems
5. Critically evaluate model performance and interpret results
6. Write reports in which results are assessed and summarized in relation to aims, methods and available data.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** to design and implement various types of neural networks, including feed forward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs), for solving real-world problems.
CO2	**Analyze** the optimizing neural network architectures by fine-tuning hyper parameters and selecting appropriate activation functions.
CO3	**Analyze** and apply deep learning techniques to solve complex tasks such as image classification, natural language processing, and time-series analysis.
CO4	**Implement** the neural network models, interpret their results, and make informed decisions about model improvements and adjustments to data-driven decision-making processes.

CO5	**Understand** selecting appropriate activation functions and employing regularization techniques to improve model performance and prevent overfitting.
MODULE NUMBER	**COURSE CONTENT**
1	**Intro to Machine Learning and Neural Networks: [4P]** supervised learning, linear models for regression, basic neural network structure, simple examples and motivation for deep networks.
2	**Lab 1: Introduction of Tensor Flow: [4P]** Intro to Tensor Flow, simple ML examples.
3	**Lab 2: Neural Networks: [8P]** Forward propagation, cost functions, error back propagation, training by gradient descent, bias/variance and under/overfitting, regularization. Exercises on NNs, solving a problem with NNs on TensorFlow.
4	**Lab 3- Convolutional Neural Networks:[8P]** Convolutional networks. Exercises on CNNs, solving a problem with CNNs on TensorFlow.
5	**Lab 3- Recurrent Neural Networks.: [8P]** Recurrent networks. Exercises on RNNs, solving a problem with RNNs on TensorFlow.
Textbook: 1. Bishop, Pattern Recognition and Machine Learning. Chapters 1, 3, 5. 2. Goodfellow et al., Deep Learning. Chapters 5, 6, 7, 9, 10	

SYLLABUS	
Semester – 6th	
Course Name	**Machine Learning Lab**
Course Code	**CT692**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Pre-requisites:
Data Structure, Design and Analysis of Algorithms, Statistics, Artificial Intelligence, Python Programming

Course Objectives:

1. Comprehend and Implement the fundamental concepts of the evolving technologies in machine learning such as Supervised and Unsupervised Learning
2. Formulate an engineering problem within the scope of machine learning paradigm.
3. Implement the concepts of machine learning to solve problems of making automated decisions dealing with large scale data.
4. Develop and Implement ideas for proposing solutions to the challenging problems of machine learning
5. Analyze the effectiveness of various machine learning Frameworks using appropriate tools.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** and **Implement** the basics concepts of machine learning to **Explain or Illustrate** and **Identify** problems where students can **Apply** the concept appropriately to **Solve** them.
CO2	**Understand and Implement** the fundamental concepts of regression analysis so that they can propose models for predicting values based on exemplary data and Analyze their performances.
CO3	**Understand** and **Implement** the fundamental strategies of unsupervised machine learning paradigm to solve clustering problems and **Analyze** their performances.
CO4	**Understand** and **Implement** the concepts of Mining Frequent Patterns, Associations and Data Streams and Apply them to solve the relevant problems and **Analyze** their performances.
CO5	**Develop** ideas to **Propose** solutions to the problems of supervised learning and **Identify** problems where students can **Apply** and **Implement** the concept appropriately with adequate documentation in collaborative environment for successfully carrying out projects on machine learning problems and **investigate** thei effectiveness by **analyzing** the performances using proper techniques and tools and **Assess** the limitations of solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

CO–PO Mapping:

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

MODULE NUMBER	COURSE CONTENT
1	WEEK-1: Introduction to Machine Learning Programming Platform& Python Programming Basics Introduction to Machine Learning Programming Platform and Python Programming Basics
2	WEEK-2: Data Exploration Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Feature Vectors, Data Preprocessing: Data Cleaning, Data Transformation
3	WEEK -3: Regression Implementation and Analysis of Linear and Nonlinear Regression Methods
4	WEEK -4: Classification Implementation and Analysis of k-Nearest-Neighbour Classifier, Decision Tree Classifier, Naïve Bayes Classifier
5	WEEK -5: Classification Implementation and Analysis of ANN-Backpropagation and SVM Based Classifier
6	WEEK-6: Clustering Implementation and Analysis of k-Means and k-Medoids

7	WEEK -7: Association Analysis Implementation and Analysis of Apriori Algorithm
8	WEEK -8: Mining Time-Series Data Implementation and Analysis of Time-Series Data Mining Models
9	WEEK -9: Discussion on Project Problems and Allocation (Problem Description Report Submission)
10	WEEK -10: Designing Solution Model and Proposal Report Submission
11	WEEK -11: Project Implementation, Verification and Documentation
12	WEEK -12: Project Demonstration and Project Report Review

Textbook:

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow, AurélienGéron, O'Reilly
2. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
3. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

Reference Books:

1. Machine Learning by SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson.
2. Machine Learning using Python, Manaranjan Pradhan and U Dinesh Kumar, Wiley

SYLLABUS	
Semester – 6th **B.PRACTICAL**	
Course Code	**CT693**
Course Name	**Digital image processing Lab**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Pre-requisites:

Knowledge of C programming and MATLAB: Design and Analysis of Algorithms, UG Level Mathematics, Python/MATLAB Programming.

Course Objective:

The objective of the course is to make the students able to -

1. Understand the practical aspects of digital image processing and identify problems where students can implement the concept appropriately.

2. Understand the practical aspects of image enhancement strategies and identify the scope of enhancement where students can apply the appropriate strategy and analyze the performance.

3. Implement the fundamental image restoration strategies and apply them appropriately to eliminate noise in the image.

4. Implement various Image Compression Techniques and Analyze their performances.

5. Understand the ideas of Morphological Image Processing and Image Segmentation and implement them to solve related problems and analyze the effectiveness as well as limitations of the solutions underscoring its utilitarian importance for further explorations leading towards lifelong learning.

Course Outcomes:	
After completion of the course students will be able to	
CO1	Understand the practical aspects of digital image processing and identify problems where students can implement the concept appropriately.
CO2	Understand the practical aspects of image enhancement strategies and identify the scope of enhancement where students can apply the appropriate strategy and analyze the performance.
CO3	Implement the fundamental image restoration strategies and apply them appropriately to eliminate noise in the image.
CO4	Implement various Image Compression Techniques and Analyze their performances.
CO5	Understand the ideas of Morphological Image Processing and Image Segmentation and implement them to solve related problems with adequate documentation in collaborative environment demonstrating the ability to carry out projects and investigate their effectiveness by analyzing the performances using proper techniques and tools and assess the limitations of the solutions underscoring utilitarian importance for further explorations leading towards lifelong learning.

CO-PO Mapping:

COs	**PO 1**	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO 2**	**PSO3**
CO1	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	3	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	3	3	-	-	-	3	3	3
CO5	-	-	-	-	-	-	3	-	3	-	-	3	2	3

MODULE NUMBER	COURSE CONTENT
1.	WEEK-1: Introduction to Digital Image Processing Basics & Python/MATLAB Programming Basics Introduction to Digital Image Processing Basics and Python/MATLAB Programming Basics.
2.	WEEK-2: Image Enhancement in Spatial Domain Implementation of various image enhancement strategies in Spatial Domain.
3.	WEEK -3: Image Enhancement in Frequency Domain Implementation of various image enhancement strategies in Frequency Domain.
4.	WEEK -4: Image Restoration Implementation of various Image Restoration strategies
5.	WEEK -5: Morphological Image Processing Implementation of various Morphological Image Processing strategies
6.	WEEK-6: Image Compression Implementation of various Image Compression strategies.
7.	WEEK -7: Image Segmentation: Detection of Points, lines and Edges (Sobel and Canny); Edge Linking Implementation of various techniques for Detection of Points, lines and Edges (Sobel and Canny); Edge Linking
8.	WEEK-8: Image Segmentation: Image Thresholding (Otsu's method), Region based segmentation colorfeature based segmentation in color images Implementation of various techniques for Image Thresholding (Otsu's method), Region based segmentation, color-feature based segmentation in color images.
9.	WEEK -9: Discussion on Project Problems and Allocation (Problem Description Report Submission).
10.	WEEK -10: Designing Solution Model and Proposal Report Submission
11.	WEEK -11: Project Implementation, Verification and Documentation
12.	WEEK -12: Project Demonstration and Project Report Review

Textbook:

1 Digital Image ProcessingusingMATLAB, Rafael C. Gonzales, Richard E. Woods, Steven L. Eddins, Pearson Education.
2 OpenCV with Python By Example, Prateek Joshi, oreilly.

Reference Books:

1. Practical Python and Open CV: An Introductory, Example Driven Guide to Image Processing and Computer Vision, Adrian Rose brock, PyImage Search.
2. Image Processing, analysis and Machine Vision, Milan Sonka , Thomson Press India Ltd, Fourth Edition.

R25 (B.Tech. CST)

Curriculum & Syllabus for B. Tech Under Autonomy

Incorporation of NEP 2020

4th Year 7th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hoursperweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	CT701	Soft Computing	3	0	0	3	3
2	ENGG	Major	CT702A	Data Mining And Warehousing	3	0	0	3	3
			CT702B	Introduction to Internet of Things					
			CT702C	Information Theory and Coding					
3	ENGG	Major	CT703A	Quantum Computing	3	0	0	3	3
			CT703B	Distributed System					
			CT703C	Bio-informatics					
			CT703D	Robotics					
4	HUM	Minor	HU(CT)701	Human Resource Development and Organizational Behavior	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	CT791	Soft Computing Lab	0	0	3	3	1.5
2	ENGG	Major	CT792A	Data Mining Lab	0	0	3	3	1.5
			CT792B	Introduction to Internet of Things Lab					
			CT792C	Information Theory and Coding Lab					
3	PRJ	Project	PR781	Project-III	0	0	12	16	8
Total of Theory & Practical								31	22

SYLLABUS	
Semester – 7th	
Course Code	**CT701**
Course Name	**Soft computing**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:
Discrete Mathematics, Probability and Statistics

Course Outcome(s):
After completion of the course students will be able to

CO1	Understand and explain the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2	Identify and formulate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems
CO3	Explore relevant literature and apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4	Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem
CO5	Implement the concept and techniques of designing of soft computing methods in real world problem.

MODULE NUMBER	**COURSE CONTENT**
1	Introduction to Soft Computing:[8L] An Overview of Artificial Intelligence, Evolution of Computing - Soft Computing Constituents – From Conventional Artificial Intelligence to Computational Intelligence - Machine Learning Basics. Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing
2	Fuzzy sets and Fuzzy logic :[8L] Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.
3	Artificial Neural Networks:[8L] Artificial Neural Network: Introduction, basic models, Hebb's learning, Adeline, Perception, Multilayer feed forward network. Back propagation, Different issues regarding convergence of Multilayer Perceptron,

	Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.
4	Genetic Algorithms:[8L] Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of Genetic Algorithm, Analysis of selection operations, Hypothesis of building Blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.
5	Hybrid Systems: [4L] Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic controlled Genetic Algorithm. Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Text book:

1."Neural Networks, Fuzzy logic, and Genetic Algorithms", S. Rajasekaran & G. A. V. Pai , PHI.
2."Principles of Soft Computing", S.N. Sivanandam, S.N Deepa, wiley publications.

Reference Books:

1. "Genetic Algorithms in Search, Optimization and Machine Learning", David E. Goldberg, Addison Wesley, 1997.
2. "Intelligent Hybrid Systems", D. Ruan, Kluwer Academic Publisher, 1997.
3. "Neural Networks", S. Haykin, Pearson Education, 2ed, 2001.
4. "An Introduction to Genetic Algorithm", Mitchell Melanie, Prentice Hall, 1998.

CO – PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT702A**
Course Name	**Data Mining and Warehousing**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Pre-requisites:
Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Objectives:

1. Comprehend the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) and Data Warehousing (such as Data Cube and OLAP)
2. Formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.
3. Apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with large scale data.
4. Develop and Implement ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.
5. Analyze the effectiveness of various Data Mining and Data Warehousing Frameworks.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand and explain** the fundamental concepts of the evolving technologies in Data Mining (such as Mining Frequent Patterns and Data Streams, Associations, Supervised and Unsupervised Learning, Graph Mining, Web Mining etc.) andData Warehousing (such as Data Cube and OLAP)recognizing their utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem within the scope of Data Mining and Data Warehousing paradigm.
CO3	**Explore** relevant literature and **apply** the concepts of Data Mining and Data Warehousing to **solve**problems of making automated decisions dealing with large scale data.
CO4	**Develop** ideas for **proposing** solutions to the challenging problems of Data Mining and Data Warehousing.
CO5	**Implement** ideas of Data Mining and Data Warehousing through **developing** feasible algorithms or frameworks and **investigate** their effectiveness in solving the relevant problems by **analyzing** the performances using proper techniques.
MODULE NUMBER	**COURSE CONTENT**
1.	**Introduction to Data Mining [5L]** Basic Concepts, Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Similarity Measures; Data Pre-processing: Data Cleaning,

	Data Integration, Data Reduction, Data Transformation & Discretization.
2.	**Introduction to Data Warehousing [6L]** Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP (OnLine Analytical Processing); Data Warehouse Design, Usage, and Implementation; Data Generalization by Attribute-Oriented Induction.
3.	**Mining Frequent Patterns, Associations and Correlation Analysis [5L]** Basic Concepts, Frequent Itemset Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent Item Sets Using Vertical Data Format, Correlation Analysis; Pattern Mining in Multilevel and Multidimensional Space.
4.	**Classification and Regression [6L]** Basic Concepts, k-Nearest-Neighbour Classifier, Decision Tree Classifier, Naïve Bayes Classifier; ANN-Backpropagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods.
5.	**Clustering and Outlier Analysis [5L]** Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on Connected Regions with High Density, Frequent Pattern–Based Clustering Method; Outlier Analysis.
6.	**Mining Data Stream, Time-Series, and Sequence Data [3L]** Basic Concepts of Data Stream Mining; Mining Time Series Data; Mining Sequence Patterns in Biological Data.
7.	Introduction to Graph Mining, Social Network Analysis, Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining [6L] Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach & Pattern Growth Approach); Basic Concepts of Social Network Analysis and Multi-relational Data Mining; Basic Concepts of Text Mining; Basic Concepts of World Wide Web (WWW) Mining.
Textbook: 1. Han J &Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition. 2. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.	
Reference Books: 1. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education. 2. Robert Layton, "Learning Data Miningwith Python", Packt Publishing	

CO–PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT702B**
Course Name	**Introduction to Internet of Things**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisite:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective(s):

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcome(s):

After completion of the course students will be able to

CO1	Understand and differentiate the fundamental concepts of Internet of Things and the Internet.
CO2	Demonstrate the concepts of wireless sensor network, Analyze and Identify appropriate
CO3	Analyze and compare the basic protocols used in different OSI layer of wireless sensor netwo and IoT.
CO4	Describe IoT architecture and Machine to machine communication.
CO5	Design basic IoT applications and Solve different real life problems in different domains bas upon the concept of IoT and sensor network.

MODULE NUMBER	COURSE CONTENT
1	**Wireless Sensor Network[9L]** Wireless sensor network, application of it, sensor nodes, Network & Communication aspec Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment & No discovery, Data aggregation & dissemination.
2	**Fundamental of IoT [4L]** The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Thin Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Intern Technologies, Infrastructure, Networks and Communication, Design challenges, Developme challenges, Security challenges, other challenges.
3	**IoT and M2M[7L]** A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains An emerging industrial structure for IoT, The international driven global value chain and

	global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
4	**IoT Architecture [7L]** Introduction, ArchitectureReference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
5	**IoT Applications for Value Creations [5L]** Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities,Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT health care, Value for Industry, smart home Management.
6	**Internet of Things Privacy, Security and Governance [4L]** Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security. Data analytics in IoT.

Text books:

1.Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.

2.Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference books:

1.Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1

2.Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT702C**
Course Name	**Information Theory and Coding**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Pre-requisites:
Probability & Statistics

Course Objective:

The objective of the course is to make the students able to

1. Illustrate the basic concept of information and apply this knowledge in designing solution.
2. Illustrate the basic concept of coding theory and use this knowledge to design and solve problem.
3. Interpret the concept of channel models to determine the mutual information in the channels.
4. Compare the existing error detection techniques and design a model for building a new solution.
5. Understand convolutional theory and develop a new approach.

Course Outcomes:

After completion of the course students will be able to

CO1	**Illustrate** the basic concept of information and **apply** this knowledge to **design** solution for real life engineering problem.
CO2	**Illustrate** the basic concept of coding theory and **use** this knowledge to **design** and **solve** mathematical and engineering problem leading to lifelong learning.
CO3	**Interpret** the concept of channel models to **find** amount of mutual information in the channels.
CO4	**Compare** the existing error detection techniques and **design a model** for **building** a new solution as a professional engineering practice as a team.
CO5	**Understand** how convolutional theory works and **develop** an approach by means of existing and new methods as a team work.
MODULE NUMBER	**COURSE CONTENT**
1.	Information Theory **[4L]** Introduction, Measure of Information, Average Information Content (Entropy) of a Zero Memory Source, Extension of Zero Memory Source, Entropy of a Source with Memory.
2.	Source Coding **[9L]** Introduction, Types of Codes, Prefix Codes, Source Coding Theorem, Shannon's Encoding Theorem, Huffman Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, An Overview on Speech and Image Compression
3.	Information Channels**[4L]** Introduction, Channel Models, System Entropies, Mutual Information (Trans information), Channel Capacity, Capacity of Channels, Continuous Channels.

4.	Error Control Coding **[8L]** Introduction, need for Error Control Coding, Types of Codes, Coding Gain, Linear Block Codes, The Hamming Codes, Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes, Cyclic Codes, Golay Codes, Shortened Cyclic Codes.
5.	Burst Error Correcting Codes **[6L]** Introduction, Burst Errors, Interleaved Codes, Product Codes, Fire Codes, BCH Codes, Non-Binary BCH Codes and Reed-Solomon Codes.
6.	Convolution Codes**[5L]** Introduction, Convolution Encoder, Representation of Convolution Code, Transfer Function of a Convolution Code, Distance Properties of Convolution Codes, Decoding of Convolution Codes, Stack Algorithm, Known Good Convolution Codes.
Textbook: 1. Information theory, coding and cryptography - Ranjan Bose; TMH. 2. Information and Coding - N Abramson; McGraw Hill.	
ReferenceBooks: 1.Introduction to Information Theory - M Mansurpur; McGraw Hill. 2. Information Theory - R B Ash; Prentice Hall. 3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.	

CO–PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT703A**
Course Name	**Quantum Computing**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisites:
Discrete Structures

Objective of the course:

The objective of the course is to make the students able to –

1. Understand the basic idea of quantum computing including background of mathematics and physics.
2. Understand and explain the concept of quantum circuits using single and multiple qubit gates and also designing of quantum circuits.
3. Compare between classical and quantum information theory and explain and apply Bell states, Quantum teleportation, Quantum Cryptography and no cloning theorem.
4. Understand, explain and apply different quantum algorithms including classical computation on quantum computers like Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search and also relate between quantum and classical complexity classes.
5. Understand noise and error correction including graph states and codes, quantum error correction, fault-tolerant.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the basic idea of quantum computing including background of mathematics and physics required for **developing** and **solving** complex engineering problem in the domain of quantum computing possibly using modern engineering tools.
CO2	**Understand** and **explain** the concept of quantum circuits **using** single and multiple qubit gates and also **designing** of quantum circuits for solving engineering problem including societal and environmental issues.
CO3	**Compare** between classical and quantum information theory and **explain** and **apply** Bell states, Quantum teleportation, Quantum Cryptography and no cloning theorem in **solving** engineering problem possibly in a team maintain proper ethics of professional collaboration.
CO4	**Understand, explain and apply** different quantum algorithms including classical computation on quantum computers like Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search and also **relate** between quantum and classical complexity classes for solving engineering problem.
CO5	**Understand** noise and error correction including graph states and codes, quantum error correction, fault-tolerant computation and **apply** it in **designing** and **solving** complex engineering problems leading to their lifelong learning.

MODULE NUMBER	COURSE CONTENT
1.	**Introduction to Quantum Computation: 8L** Quantum bits, Bloch sphere representation of a qubit,multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities andmeasurements, entanglement, density operators and correlation, basics of quantum mechanics,Measurements in bases other than computationalbasis.
2.	**Quantum Circuits: 6L** Single qubit gates, multiple qubit gates, design of quantum circuits.
3.	**Quantum Information and Cryptography: 6L** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.
4.	**Quantum Algorithms: 8L** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.
5.	**Noise and error correction: 8L** Graph states and codes, Quantum error correction, fault-tolerant computation.

Text book:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms

Reference Books:

1. P Kaye, R Laflamme and M Mosca, An Introduction to Quantum Computing.
2. Eleanor G. Rieffel , Wolfgang H. Polak , "Quantum Computing - A Gentle Introduction" (Scientific and Engineering Computation)
3. Yanofsky's and Mannucci, Quantum Computing for Computer Scientists.
4. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd.
5. Scott Aaronson, "Quantum Computing since Democritus", Cambridge.
6. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge.

CO – PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT703B**
Course Name	**Distributed Systems**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Prerequisite:

The students have the basic knowledge of Computer Organization Architecture, Distributed System and Operating System.

Course Objective(s)

1. To introduce the concepts of Modern Processors.
2. To introduce Optimization techniques for serial code.
3. To introduce Parallel Programming using OpenMP and MPI

Course Outcome(s)

After competition of the course the student able to do

CO1	Understand of the parallel architecture and Programming
CO2	Design parallel programs develop CUDA programs for GPU.
CO3	Analyze and apply various parallel algorithms.
CO4	Capable to optimize algorithms for better performance
CO5	Understanding the distributed system

MODULE NUMBER	COURSE CONTENT
1	**Introduction of Parallel Programming: [7L]** **Introduction:[2L]** Scope, issues, applications and challenges of Parallel and Distributed Computing **Parallel Programming Platforms:[2L]** Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms, Physical Organization, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, GPU, co processing. **Principles of Parallel Algorithm Design:[3L]** Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing.
2	**CUDA programming model: [7L]** **CUDA programming model**: Overview of CUDA, Isolating data to be used by parallelized code, API function to allocate memory on parallel computing device, to transfer data, Concepts of Threads, Blocks, Grids, Developing a kernel function to be executed by individual threads, Execution of kernel function by parallel threads, transferring data back to host processor with API function.
3	**Analytical Modeling of Parallel Programs: [7L]** **Analytical Modeling of Parallel Programs:** Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time.
4	**Algorithms: [11L]** **Dense Matrix Algorithms:[4L]** Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms

	Graph Algorithms:[4L] Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected Components, Algorithms for Sparse Graph. **Search Algorithms for Discrete Optimization Problems:[3L]** Sequential Search Algorithms, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms.
5	**Models of distributed computation [4L]** **Models of distributed computation**; Design issues; Operating systems for distributed computing: Distributed algorithms and applications, Clock synchronization algorithms; Distributed memory systems; Message passing; Middleware; Point to-point communication; Fault Tolerance; Fault tolerant routing.

Text books:

1. A Grama, AGupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003. 2. C Lin, L Snyder.
2. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 2008.
3. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming.

Reference Books

1. Morgan Kaufmann Publishing and Elsevier, 2013.
2. T Mattson, B Sanders, B
3. Massingill. Patterns for Parallel Programming. Addison-Wesley Professional, 2004.

CO-PO & PSO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT703C**
Course Name	**Bio-informatics**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Course Objective(s):

The objective of the course is to make the student able to:

1. Familiar with the basic concept of the Bioinformatics and Molecular Biology and also Familiar with a variety of currently available genomic and proteomic databases.
2. Search and retrieve information from genomic and proteomic databases (e.g. GenBank, Swiss-Prot), and to analyze their search results using software available on the internet (e.g. BLAST, ClustalW).
3. Familiar with the principles and applications of microarraysand locate consensus sequences, genes and open reading frames within biological sequences.
4. Learn how to compare and analyze biological sequences and how to interpret the results of their analyses and how to construct phylogenetic trees based on biological sequence data.
5. Perform elementary predictions of protein structure and function and use the scientific method of inquiry, through the acquisition of scientific knowledge.

Course Outcomes:

After completion of the course students will be able to

CO1	Acquire the knowledge of Bioinformatics technologies with the related concept of DNA, RNA and their implications
CO2	Develop idea in Molecular Biology
CO3	Understand the concept and techniques of different types of Data Organization and Sequence Databases with different types of Analysis Tools for Sequence Data Banks
CO4	Acquire the knowledge of the DNA Sequence Analysis
CO5	Analyze the performance of different types of Probabilistic models used in Computational Biology
MODULE NUMBER	**COURSE CONTENT**
1	**Introduction to Molecular Biology[8L]** Concepts of Cell, tissue, types of cell, components of cell, organelle, Functions of different organelles; Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept; Concepts of RNA: Basic structure, Difference between RNA and DNA. Types of RNA Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Translation, Introduction to Metabolic Pathways. Introduction to Bioinformatics, Recent challenges in Bioinformatics.

2	**Introduction to Genomic and MSDN [10L]** Introduction to Genomic data, Data Organization and Sequence Databases: Sequence Data Banks - Introduction to sequence data banks - protein sequence data bank. Signal peptide data bank, Nucleic acid sequence data bank - GenBank, AIDS virus sequence data bank. RRNA data bank, structural data banks - protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank - Metabolic pathway data : Microbial and Cellular Data Banks. Introduction to MSDN (Microbial Strain Data Network):Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; Protein Sequence Databases, DNA sequence databases, sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed;
3	**DNA Sequence Analysis[8L]** DNA Mapping and Assembly: Size of Human DNA,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Secondary Structure predictions; Prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking Tertiary Structure predictions; Prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking
4	**Introduction Probabilistic models used in Computational Biology [10L]** Probabilistic Models; Gene Regulatory Method Application of HMM in Bioinformatics:Genefinding, profile searches, multiple sequence alignment and regulatory site identification. Applications in Biotechnology: Protein classifications, Fold libraries, Protein structure prediction: Fold recognition (threading), Protein structure predictions: Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling& Dynamics, Drug Designing.

Text Book:

2. Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", First Indian Reprint, Springer Verlag, 2007.

References Book:

1. Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2005

CO-PO Mapping

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

SYLLABUS	
Semester – 7th	
Course Code	**CT703D**
Course Name	**Robotics**
Lecture (per week)	**3**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**3**

Pre-requisite:

1. Microprocessor & Microcontroller
2. Computer Organization & Architecture

Course Objective(s):

1. To study microcontroller operations for robotics.
2. To study how different interfaces are actually implemented in a microcontroller.
3. To learn how Microchip PIC micro PIC16F627 can be erased and reprogrammed
4. To learn how different sensors, outputs, and peripherals can be wired to a microcontroller to work cooperatively and create a high-level control program.
5. To design robots in a real time environment.

Course Outcome(s):

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

CO1	**Understand** the basic concepts of robotics exploring the characteristics of its various components, motion control, actuator and drive system and the functions of various sensors in robotics, and robot programming.
CO2	**Apply** the concepts of robotics for machine loading and their kinematics and **analyze** the kinematics of serial and parallel robots, motion control systems.
CO3	**Illustrate** concepts of Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators.
CO4	**Understand** classical control concepts and **use** advanced topics in non-linear control of manipulators.
CO5	**Develop** algorithmic solutions and corresponding robot-programs for designing various robotic systems.
MODULE NUMBER	**COURSE CONTENT**
1	**[6L]** Brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals. Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, commonsensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.
2	**[8L]** Introduction, Direct and inverse kinematics problems, Examples of kinematics of common

	serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator. Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.
3	**[8L]** Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics. Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators
4	**[8L]** Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.
5	**[6L]** Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR‘s on uneven terrain, Simulations using Matlab and ADAMS. Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE‘s).

Textbooks:

Myke Predko, ―Programming Robot Controllers‖ – McGrawHill, 1st edition, 2003.

Reference books:

1. Michael slater, ―Microprocessor – based design: A comprehensive Guide to Effective Hardware Design, Prentice Hall, 1989.
2. Myke Predko, ―Programming and customizing the 8051- micro-controller‖, Tata McGraw-Hill, New Delhi, 2000.

CO-PO Mapping

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

SYLLABUS	
Semester – 7th	
Course Code	**HU(CT)701**
Course Name	**Human Resource Development and Organizational Behavior**
Lecture (per week)	**2**
Tutorial (per week)	**0**
Contact Hours (per week)	**2**
Total Contact Hours	**24**
Credit	**2**

Course Objective(s):

1. To develop an understanding of the nature, functioning and design of organization as social collectivizes.
2. The basic concepts and theories underlying individual behavior besides developing better insights into one's own self.
3. To gain insight into the organizational learning processes, how they can be fostered and enhanced.
4. Individual behavior in groups, dynamics of groups and team building besides developing a better awareness of how they can be better facilitators for building effective teams as leaders themselves.

Course Outcome(s):

At the end of the course students are able to:

CO1	To understand key functions in management as applied in practice.
CO2	To identify and analyze major practices associated with HRD in modern work and organization
CO3	To evaluate the connections between the HRD process and the contemporary performance management concerns of organizations
CO4	To assess the potential effects of organizational-level factors (such as structure, culture and change) on organizational behavior.
CO5	To evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behavior
MODULE NUMBER	**COURSE CONTENT**
1	HRD-Macro Perspective: HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate. **[2L]**
2	HRD–Micro Perspective: Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD [**4L]**

3	Instructional Technology for HRD: Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behavior Modeling and Self Directed Learning; Evaluating the HRD. [**4L]**
4	Human Resource Training and Development: Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training Managers. [**3L]**
5	Organizational Effectiveness (OE): Concept; Approaches to O E; Adoptive Coping Cycle for Effectiveness; Achieving OE; Organizational Climate: Concept, Determinants of Organizational Climate. [**2L]**
6	Organization Theory: Classical Theory; Neo-Classical Theory, Modern Behavioral Theories, contingency theory, system theory, modern structural models; Organizational Culture; Creating and Sustaining Culture; Work Culture. [**4L]**
7	Motivation: Types of Motives; Theories of Maslow; Herzberg, McGregor, Alderfers, Porter and Lawler's Model; Job Enlargement, Job Enrichment, Behaviour Modification. [**2L]**
8	(a)Group & Group Dynamics - concept, importance, classification of groups, reason for group, formation, group cohesiveness. (b) Team work: meaning, concept, types, creating, and an effective team. (c) Leadership: Concept, Leader vs. Manager; Classical Studies on Leadership; Trait Theories; Behavioral Theories; Group and Exchange Theories; Contingency Theory of Leadership; Leadership Styles. [**3L]**

References:

1) Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi , 2005
2) Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.
3) Rao, T.V: Human Resource Development, Sage Publications, New Delhi.
4) Luthans, Fred: Organizational Behavior, Tata McGraw-Hill Co. New Delhi, 2004.
5) Stephen, P. Robins: Organizational Behavior, Prentice-Hall of India Pvt., Ltd., 2004.
6) John, W. Mewstrom & Davis, Keith :Organizational Behavior (Human Behavior at Work), Tata McGraw-Hill, New Delhi , 2002

CO-PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT791**
Course Name	**Soft Computing Lab**
Lecture (per week)	**0**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites:
Programming concepts, Discrete Mathematics, Probability and Statistics

Course Outcome(s):
After completion of the course students will be able to

CO1	Understand and explain the basic concept of soft computing and hard computing and apply them in designing solution to engineering problem.
CO2	Identify and formulate learning rules for each of the architectures and learn several neural network paradigms and its applications to solving engineering and other problems
CO3	Explore relevant literature and apply fuzzy logic and reasoning to handle uncertainty and solving interdisciplinary engineering problems
CO4	Use genetic algorithms to combinatorial optimization problems and recognize the feasibility of applying a soft computing methodology for a particular problem
CO5	Implement the concept and techniques of designing of soft computing methods in real world problem.

MODULE NUMBER	COURSE CONTENT
1.	Implementation of De-Morgan's Law
2.	Performing Union, Intersection and Complement operations
3.	Write a program to implement artificial neural network with back propagation.
4.	Write a program to implement artificial neural network without back propagation.
5.	Implementation of operations on Fuzzy Sets.
6.	Implement Crisp partitions for real life iris dataset
7.	Write a program to implement Logic gates.
8.	Implement SVM classification of Fuzzy Sets
9.	Implement ABC (Artificial Bee Colony) optimization Technique.
10.	Implementation DE (Differential Evolution) algorithm.

Textbook:
1. "Neural Networks, Fuzzy logic, and Genetic Algorithms", S. Rajasekaran & G. A. V. Pai , PHI.
2. "Principles of Soft Computing", S.N. Sivanandam, S.N Deepa, wiley publications.

Reference Books:
1. "Genetic Algorithms in Search, Optimization and Machine Learning", David E. Goldberg, Addison Wesley, 1997.
2."Intelligent Hybrid Systems", D. Ruan, Kluwer Academic Publisher, 1997.
3."Neural Networks", S. Haykin, Pearson Education, 2ed, 2001.
4."An Introduction to Genetic Algorithm", Mitchell Melanie, Prentice Hall, 1998.

CO–PO Mapping:

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

SYLLABUS

Semester – 7th

Course Code	**CT792A**
Course Name	**Data Mining Lab**
Lecture (per week)	**0**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**3**
Credit	**1.5**

Prerequisites:

Data Structure& Programming, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Python Programming

Course Objectives:

The objective of the course is to enable students to

1. Comprehend the practical aspects of Data Mining and Data Warehousing through implementationof ideas using proper techniques and tools.
2. Formulate a problem to fit Data Mining and Data Warehousing frameworks by exploring the contextual data and its characteristics.
3. Explore the well-known strategies of Data Mining and Data Warehousing by implementing their respective algorithmic solutions to large scale data using proper techniques and tools to solve contextual problems.
4. Develop ide as and propose technical solutions to the challenging problems of Data Mining and Data Warehousing.
5. Analyze the effectiveness of a Data Mining Modeland Data Warehousing Frameworksin offering solutions to the respective problem.

Course Outcomes:

After completion of the course students will be able to

CO1	**Understand** the practical aspects of Data Mining and Data Warehousing through implementation of ideas using proper techniques and tools to recognize heir utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by exploring contextual data and its characteristics within the scope of Data Mining and Data Warehousing paradigm.
CO3	**Explore** relevant literature and **apply** the concepts of Data Mining and Data Warehousing by **implementing** well-known algorithmic solutions to large scale data using proper techniques and tools to **solve** contextual problems.
CO4	**Develop** ideas and **propose** technical solutions to the challenging problems of Data Mining and Data Warehousing.
CO5	**Plan and Implement** Data Mining based ideas as executable programs **(**preferably termed as models) **by developing** suitable algorithms with adequate documentation in collaborative environment for successfully carrying out projects on Data Mining and Data Warehousing and **investigate** their effectiveness by **analyzing** the performances using proper techniques and tools.
MODULE NUMBER	**COURSE CONTENT**

1	Introduction to Data Mining Programming Platform Introduction to Data Mining Programming Platform and Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization, Data Feature Vectors, Data Preprocessing: Data Cleaning, Data Transformation
2	Affinity Analysis Implementation and Analysis of Recommending Engine
3	Association Analysis Implementation and Analysis of Apriori Algorithm
4	Regression Implementation and Analysis of Linear and Nonlinear Regression Methods
5	Classification Implementation and Analysis of k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier
6	Classification Implementation and Analysis of ANN-Backpropagation and SVM Based Classifier
7	Clustering Implementation and Analysis of k-Means and k-Medoids
8	Mining Time-Series Data Implementation and Analysis of Time-Series Data Mining Models
9	Discussion on Project Problems and Allocation (Problem Description Report Submission)
10	Designing Solution Model and Proposal Report Submission
11	Project Implementation, Verification and Documentation
12	Project Demonstration and Project Report Review

Textbook:

1. Han J &Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.
2. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

Reference Books:

1. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", PearsonEducation.
2. Robert Layton, "Learning Data Miningwith Python", Packt Publishing

CO–PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT792B**
Course Name	**Introduction to Internet of Things Lab**
Lecture (per week)	**0**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**36**
Credit	**1.5**

Prerequisites:

1. Fundamental knowledge in computer networking.
2. Basic knowledge of Microcontroller fundamentals.

Course Objective: Students will understand the concepts of Internet of Things and can able to build IoT applicatio practically.

Course Outcome(s):
Upon successful completion of the course/Lab the students will be able to

CO1	Understand and differentiate the fundamental concepts of Internet of Things and the Internet.
CO2	Demonstrate the concepts of wireless sensor network, Analyze and Identify appropriate
CO3	Analyze and compare the basic protocols used in different OSI layer of wireless sensor network a IoT.
CO4	Describe IoT architecture and Machine to machine communication.
CO5	Design basic IoT applications and Solve different real life problems in different domains based upon t concept of IoT and sensor network.

MODULE NUMBER	COURSE CONTENT
1.	Controlling the Light Emitting Diode (LED) with a push button.
2.	Interfacing the RGB LED with the Arduino
3.	Controlling the LED blink rate with the potentiometer interfacing with Arduino
4.	Detection of the light using photo resistor
5.	Interfacing of temperature sensor LM35 with Arduino
6.	Interfacing Servo Motor with the Arduino
7.	Interfacing of the Active Buzzer with Arduino.
8.	Interfacing of the Relay with Arduino.
9.	Building Intrusion Detection System with Arduino and Ultrasonic Sensor
10.	Directional Control of the DC motor using Arduino

Textbook:

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.

2. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Reference Books:

1.Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 978-1-4493-9357-1

2.Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

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

SYLLABUS	
Semester – 7th	
Course Code	**CT792C**
Course Name	**Information Theory and Coding Lab**
Lecture (per week)	**0**
Tutorial (per week)	**0**
Contact Hours (per week)	**3**
Total Contact Hours	**3**
Credit	**1.5**

Pre-requisites:
Knowledge of C programming and MATLAB

Course Objective:
The objective of the course is to make the students able to

1. Illustrate and apply proper code in appropriate platform using suitable syntax to solve problems.
2. Understand the concept of variables, constants, data type, operator, expression, statements, loops, vector, matrix, array, function, file handling and apply this knowledge to design the problem
3. Apply systematic approach to design the programs for solving problems.
4. Solve and analyse engineering-related computational problems by applying a variety of common numeric techniques
5. Interpret the result of the experiments, prepare laboratory reports based on observed output and analyze it.

Course Outcomes:

After completion of the course students will be able to

CO1	**Illustrate** and **apply** proper code in appropriate platform using suitable syntax for developing program to **solve** problems related to Mathematics and Engineering field leading to lifelong learning.
CO2	**Understand** the concept of variables, constants, data type, operator, expression, statements, loops, vector, matrix, array, function, file handling and **apply** this knowledge to **design** the problem using modern tools for **solvin**g complex engineering problems.
CO3	**Apply** systematic approach to **design** the programs for **solving** problems as a professional engineering practice.
CO4	**Solve** and **analyze** engineering-related computational problems by **applying**a variety of common numeric techniques
CO5	**Interpret** the result of the experiments**, prepare** laboratory reports based on observed output and**analyze** it to validate professional ethics and responsibilities and norms of the engineering practice.
MODULE NUMBER	**COURSE CONTENT**
1.	Revision on programming using C language.Familiarization with MATLAB environment setup, syntax, variables, commands, data types, operators, decisions, loops, vectors, matrix, arrays, functions, and advanced part, creating and editing basic MATLAB program in an editor, compilation and execution of MATLAB program.

2.	Determination of various entropies and mutual information using C/MATLAB of the following channels a. Noise free channel b. Noisy channel
3.	Generation and evaluation of following variable source coding using C/MATLAB a. Shannon – Fano coding b. Huffman Coding and Decoding **c.** Lempel Ziv Coding and Decoding
4.	Coding & Decoding of the following codes using C/MATLAB a. Linear block codes b. Cyclic codes c. Convolutional codes
5.	Coding & Decoding of the following codes using C/MATLAB a. BCH code b. RS code
6.	ı based on a. Coded and uncoded communication system (Calculate the error probability) using C/MATLAB. b. Source coding and channel coding for transmitting a text file using C/MATLAB.

Textbook:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Process Control – A First Course with MATLAB - Pao C. Chau; Cambridge University Press

Reference Books:

1.Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
4.Information and Coding - N Abramson; McGraw Hill.

CO-PO Mapping:

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