R25 [B.Tech., ECS]

Curriculum and Syllabus for B.Tech. under Autonomy

(NEP-2020 implemented)

Dept. of Electronics and Computer Science

(Effective from 2025-26 admission batch)

R25 _Electronics and Computer Science

Curriculum & Syllabus for B. Tech Under Autonomy Incorporation of NEP 2020

1st Year 1st Semester									
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	ENGG	Minor	CS102	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU103	Design Thinking & Innovation	1	0	0	1	1
6	HUM	Value Added Courses	HU105	Constitution of India & Professional Ethics	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	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Enhancement Course	ME193	IDEA LAB Workshop	0	0	3	3	1.5
C.MANDATORY ACTIVITIES / COURSES									
1	andatory Course	MC181	nduction Program	0	0	0	0	0	0
Total of Theory, Practical								24	17.5

1st Year 2nd Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	ECS201	Introduction to Electrical and Electronics Engineering	3	0	0	3	3
2	ENGN	Major	CS201	Data Structures and Algorithms	3	0	0	3	3
3	SCI	Multidisciplinary	PH201	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M201	Engineering Mathematics – II	3	0	0	3	3
5	HUM	Value Added Course	HU201	Environmental Science	2	0	0	2	2
6	HUM	Value Added Course	HU202	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ECS291	Introduction to Electrical and Electronics Engineering Lab	0	0	3	3	1.5
2	ENGG	Major	CS292	Data structures and Algorithms Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	PH291	Engineering Physics Lab	0	0	3	3	1.5
3	ENGG	Skill Enhancement Course	ME294	Engineering Graphics & Computer Aided Design Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU291	Communication & Presentation Skill	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								30	22.5
TOTAL FIRST YEAR CREDIT									40

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	ECS302	Analog Electronic Circuits	3	0	0	3	3
3	ENGG	Major	ECS303	Digital Electronics Circuits	3	0	0	3	3
4	ENGG	Minor	EC(ECS)301	Electromagnetic Theory and Transmission Line	3	0	0	3	3
5	SCI	Minor	M(ECS)301	Discrete Mathematics	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	ECS391	Computer Organization and Architecture Lab	0	0	0	3	1.5
2	ENGG	Major	ECS392	Analog Circuits Lab	0	0	3	3	1.5
3	ENGG	Major	ECS393	Digital Electronics Lab	0	0	3	3	1.5
4	SCI	Minor	M(ECS)391	Numerical Methods Lab	0	0	0	2	1
5	HUM	Ability Enhancement Course	HU(ECS)391	Technical Seminar Presentation & Group Discussion	0	0	2	2	1
Total of Theory, Practical								28	20.5

2nd Year 4th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	ECS401	Microprocessor and Microcontrollers	3	0	0	3	3
2	ENGG	Major	ECS402	Operating Systems	3	0	0	3	3
3	ENGG	Major	ECS403	Database Management Systems	3	0	0	3	3
4	ENGG	Minor	EC(ECS)401	Communication Engineering	3	0	0	3	3
5	ENGG	Minor	CS(ECS)401	Formal Language and Automata theory	3	0	0	3	3
6	HUM	Ability Enhancement Course	CS(ECS)402	Computing with Python	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	ECS491	Microprocessor and Microcontrollers Lab	0	0	3	3	1.5
2	ENGG	Major	ECS492	Operating Systems Lab	0	0	3	3	1.5
3	ENGG	Major	ECS493	Database Management Systems Lab	0	0	3	3	1.5
4	ENGG	Minor	EC(ECS)491	Communication Engineering Lab	0	0	2	2	1
5	HUM	Ability Enhancement Course	HU(ECS)491	Soft skill & Aptitude	0	0	2	2	1
Total of Theory, Practical								26	24.5
Total Credit in 2nd Year									45

3rd Year 5th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	ECS501	Internet of Things and its applications	3	0	0	3	3
2	ENGG	Major	ECS502	Object Oriented Programming with Java	3	0	0	3	3
3	ENGG	Major	ECS503	Introduction to Data Science	3	0	0	3	3
4	ENGG	Major	ECS504A	Embedded System Design	3	0	0	3	3
			ECS504B	Digital Signal Processing					
			ECS504C	VLSI and Microelectronics					
			ECS504D	Measurement and Sensors Technology					
5	ENGG	Minor	CS(ECS)501A	Computer Graphics	2	0	0	2	2
			CS(ECS)501B	Software Engineering					
			CS(ECS)501C	Web and Internet Technology					
			CS(ECS)501 D	Ecommerce & ERP					
B. PRACTICAL									
1	ENGG	Major	ECS591	Internet of Things Lab	0	0	3	3	1.5
2	ENGG	Major	ECS592	Object Oriented Programming with Java Lab	0	0	3	3	1.5
3	ENGG	Major	ECS593A	Embedded System Design Lab	0	0	3	3	1.5
			ECS593B	Digital Signal Processing Lab					
			ECS593C	VLSI and Microelectronics Lab					
			ECS593D	Measurement and Sensors Technology Lab					
5	ENGG	Skill Enhancement Course	IT(ECS)591	IT Workshop Lab (SciLab/Python/R/C++)	0	0	3	3	1.5
6	PRJ	Project	ECS581	Project-I	0	0	0	4	2
C. MANDATORY ACTIVITIES / COURSE									

	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								31	22

3rd Year 6th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS601	Computer Networks	3	0	0	3	3
2	ENGG	Major	ECS602	Machine Learning	3	0	0	3	3
3	ENGG	Major	ECS603A	Control System Engineering	3	0	0	3	3
			ECS603B	Digital Image Processing					
			ECS603C	Information Theory and Coding					
			ECS603D	Ad-Hoc and Sensor Networks					
4	ENGG	Major	ECS604A	Data Mining	3	0	0	3	3
			ECS604B	Simulation and Modelling					
			ECS604C	Cloud Computing					
			ECS604D	Optimization Techniques					
5	ENGG	Minor	EC(ECS)605A	Wireless Communication	2	0	0	2	2
			EC(ECS)605B	Nanoelectronics					
			EC(ECS)605C	Introduction to Robotics					
			EC(ECS)605D	MEMS Technology					
6	HUM	Value Added Course	HU601	Research Methodology and IPR	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ECS691	Computer Networking Lab	0	0	3	3	1.5
2	ENGG	Major	ECS692	Machine Learning Lab	0	0	0	3	1.5
3	ENGG	Major	ECS693A	Control System Engineering Lab	0	0	3	3	1.5
			ECS693B	Digital Image Processing Lab					
			ECS693C	Information Theory and Coding Lab					
			ECS693D	Ad-Hoc and Sensor Networks Lab					
4	ENGG	Major	ECS694A	Data Mining Lab	0	0	3	3	1.5
			ECS694B	Design and Simulation lab					
			ECS694C	Cloud Computing Lab					
			ECS694D	Optimization Techniques Lab					
5	ENGG	Internship	ECS681	Internship (Min. 1 Month)	0	0	0	0	1
6	PRJ	Project	ECS682	Project-II	0	0	0	8	4
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC681	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environment al Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								35	26
Total credit in 3rd year									48

4th Year 7th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS701	Industrial Automation	3	0	0	3	3
2	ENGG	Major	ECS702A	Quantum Computing	3	0	0	3	3
			ECS702B	Blockchain Technology					
			ECS702C	Big Data Analytics					
			ECS702D	Generative AI					
3	ENGG	Minor	CS(ECS)701A	Real Time System	2	0	0	2	2
			CS(ECS)701B	Cyber Security					
			CS(ECS)701C	Neural Networks and Deep Learning					
			CS(ECS)701D	Soft Computing					
4	HUM	Skill Enhancement Course	HU(EC)701	Project Management and Finance	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	ECS791	Industrial Automation Lab	0	0	3	3	1.5
2	ENGG	Skill Enhancement Course	PR(ECS)791	Rapid Prototyping Lab	0	0	0	3	1.5
3	PRJ	Project	ECS781	Project-III	0	0	0	12	6
Total of Theory, Practical								28	19

4th Year 8th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	T	P	Total	
B. PRACTICAL									
1	PRJ	Project	ECS881	Grand Viva	0	0	0	8	4
2	PRJ	Project	ECS882	Internship/Entrepreneurship	0	0	0	8	4
Total of Theory, Practical								16	8
Total Credit in 4th year									27

Total Credit-160

Syllabus of 1st year _R25_ ECS

1st Year 1st Semester									
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	ENGG	Minor	CS102	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Ability Enhancement Course	HU103	Design Thinking & Innovation	1	0	0	1	1
6	HUM	Value Added Courses	HU105	Constitution of India & Professional Ethics	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	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1
4	ENGG	Enhancement Course	ME193	IDEA LAB Workshop	0	0	3	3	1.5
C.MANDATORY ACTIVITIES / COURSES									
1	andatory Course	MC181	nduction Program	0	0	0	0	0	0
Total of Theory, Practical								24	17.5

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:

O1: Describe the architecture, memory systems, and evolution of computers.

O2: Convert between number systems and analyze binary arithmetic including IEEE754 representation.

O3: Construct algorithms and flowcharts for basic computational problems.

O4: Implement control structures, arrays, pointers, and functions in C programs.

O5: 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	2	2	3
CO2	2	2	3	3	3	-	-	-	-	-	-	2	3	3
CO3	2	3	2	2	2	-	-	-	-	-	-	3	2	2
CO4	3	2	2	3	3	-	-	-	-	-	-	2	2	2
CO5	2	2	2	1	1	-	-	-	-	-	2	2	2	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 Yashavant Kanetkar, BPB Publications, 17th Edition
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, 2nd Edition
2. Fundamentals of Computers by V. Rajaraman and Neeharika Adabala, 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, 2nd Edition
5. Programming in ANSI C by E. Balagurusamy, McGraw Hill Education 8th Edition

Course Name: Introduction to Artificial Intelligence
Course Code: CS102
Contact: (L: T: P) 2: 0: 0
Total Contact Hours: 30
Credit: 2

Prerequisites:
Basic Computer Knowledge.

Course Objective(s):

The objective of the course is to make the students able to –
O1: Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context.
O2: Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
O3: Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute-force techniques.
O4: Design AI-Frameworks for Inferencing based on knowledge base.
O5: Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes (COs):
After Successful completion of the 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 **analysing** their performances in solving the relevant problems.

CO-PO Mapping:

CO	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	3

Course Content:

Module 1: Introduction to Artificial Intelligence (3L)

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 (8L)

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 (6L)

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 (5L)

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.

Text book:

1. **AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI),** Saptarsi Goswami, Amit Kumar Das, Amlan Chakrabarti, Pearson.
2. **Artificial Intelligence**, Rich, E., Knight, K and Shankar, Tata McGraw Hill, 3rd Edition, B. 2009.
3. **Artificial Intelligence - A Modern Approach**, Russell, S. and Norvig, Prentice Hall, 3rd edition, P. 2015

Reference Books:

1. **Artificial Intelligence: Beyond Classical AI**, Reema Thareja, Pearson.
2. **Introduction to Artificial Intelligence and Expert Systems,** Patterson, Pearson.

Course Name: Engineering Chemistry
Course Code: CH 101
Contact Hours: (L: T: P) 2: 0: 0
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2

Course Objective(s)

O1: Understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.

O2: Apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.

O3: Apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.

O4: Analyse the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.

O5: Evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices

Course Outcome (COs)
After successful completion of the course, students will be able to

CO1	Understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.
CO2	Apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.
CO3	Utilize the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.
CO4	Analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.
CO5	Evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices

CO-PO mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**
CO2	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**1**	**2**
CO3	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**1**	**1**
CO4	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**1**	**1**
CO5	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**1**	**1**	**1**

Course Content

Module 1 **(6 L)**

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 2 **(7 L)**

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 3 **(6L)**

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 4 (5L)

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

Text Books

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

Reference Books

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

Course Name: Engineering Mathematics - I
Course Code: M101
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 Objective(s):

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

O1: Develop a strong foundation in both fundamental and advanced concepts of linear algebra and calculus essential for engineering applications.

O2: Build competency in applying integration techniques in multiple dimensions, including line, surface, and volume integrals, to solve problems relevant to engineering and applied sciences.

O3: Gain proficiency in analysing multivariable functions using differentiation techniques such as partial and total derivatives, Jacobians, and methods for finding extrema.

Course Outcomes (COs):

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

CO1	Apply linear algebra methods to perform matrix operations, classify matrix structures, solve systems of linear equations, and compute eigenvalues and eigenvectors in engineering contexts.
CO2	Apply differential and integral calculus to evaluate and approximate the behaviour of single-variable and multivariable real-valued functions relevant to engineering scenarios.
CO3	Analyze the properties of eigenvalues and eigenvectors 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 behaviour in engineering applications.

CO-PO Mapping:

CO	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	-	-	-	-	-	-	-	-	1	3	3	3
CO2	3	2	-	-	-	-	-	-	-	-	1	2	3	3
CO3	3	3	1	1	-	-	-	-	-	-	2	2	3	3

CO4	3	3	1	1	-	-	-	-	-	-	2	2	3	3

Course Content:

Module I: Linear 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; Eigenvalues and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin 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: Multivariable 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. Higher Engineering Mathematics, Grewal, B.S., Khanna Publishers, 36th Edition, 2010.

2. Advanced Engineering Mathematics, 9th Edition, Kreyszig, E., John Wiley & Sons, 2006.

Reference Books:

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

	Design Thinking and Innovation		
Course Code	HU103		
(L-T-P)	(1-0-0)		
Class Hours / Week	01		
Total class hours	15		

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	appingto 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	PSO1	PSO2	PSO3
CO1	1	2	-	2	2	-	2	3	1	-	-	2	3	2
CO2	1	2	3	3	3	-	2	3	-	3	2	2	3	2
CO3	1	3	3	3	3	2	2	3	-	2	2	2	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;	2
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).	4
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	2
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	2
Module 6:	**Problem Solving & Critical thinking** Introduction to TRIZ, SCAMPER, UI and UX, **Sustainable development goals (SDG)** Integrating and mapping 17 Sustainable development goals (SDG) during designing a product; goods or service.	3

	Introduction to 21st Century Skill Set	
	Case Study & Project Report Submission	

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.
4. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox, John Wiley & Sons, 2020.
5. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook, John Wiley & Sons, 2018.
6. Kristin Fontichiaro, Design Thinking, Cherry Lake Publishing, USA, 2015.
7. Walter Brenner, Falk Uebernickel, Design Thinking for Innovation - Research and Practice, Springer Series, 2016.
8. Gavin Ambrose, Paul Harris, Design Thinking, AVA Publishing, 2010.
9. Muhammad MashhoodAlam, Transforming an Idea into Business with Design Thinking, First Edition, Taylor and Francis Group, 2019.
10. S. Balaram, Thinking Design, Sage Publications, 2011.

WEB REFERENCES:

1. https://designthinking.ideo.com/
2. https://thinkibility.com/2018/12/01/engineering-vs-design-thinking/
3. https://www.coursera.org/learn/design-thinking-innovation
4. https://swayam.gov.in/nd1_noc20_mg38/preview
5. www.tutor2u.net/business/presentations/. /productlifecycle/default.html
6. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf

7. www.bizfilings.com › Home › Marketing › Product Developmen
8. https://www.mindtools.com/brainstm.html
9. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
10. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
11. https://support.google.com/docs/answer/179740?hl=en

Course Name: **Constitution of India and Professional Ethics**
Course Code: HU105
Contact: 1:0:0
Total Contact Hours: 12
Credit: 1
Prerequisites:

A basic knowledge (10+2 level) of the Indian Constitution and moral science.

Course Objectives: The objectives of this course are to make the student able to-

O1: understand the salient features of the Indian constitution and form of government.

O2: develop ethical awareness and responsible professional conduct.

O3: understand ethical frameworks, guidelines and recognize ethical dilemmas.

O4: understand professional responsibilities and applications of ethical principles in real-life scenarios.
O5: develop an awareness of the social impact of the profession and act responsibly in the broader community.

Course outcome: After successful completion of this course, students 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.

CO-PO Mapping:

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

Course Contents:

Module 1: Introduction to the Constitution of India and Indian Government: (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: Professional Ethics and Human Values: (3L)

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

Module 3: Codes of Professional Ethics, Violation and Safeguards: (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: Business Ethics and Workplace Issues: (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.

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:

O1: Understand the fundamentals of programming logic through algorithmic thinking.
O2: Implement and debug C programs using various control structures.

O3: Apply memory management concepts using pointers and arrays.

O4: Develop structured programs involving functions and recursion.

O5: 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:

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

1. Schaum's Outline of Programming with C by Byron S. Gottfried, McGraw-Hill Education, 1st Edition (1996)
2. Let Us C by Yashavant Kanetkar, BPB Publications, 17th Edition

Reference Books:

1. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchiem, Prentice Hall, 2nd Edition
2. Mastering C by K. R. Venugopal and S. R. Prasad, Tata McGraw-Hill Education, 2nd Edition
3. Programming in ANSI C by E. Balagurusamy, McGraw Hill Education 8th Edition

Course Name: Introduction to Artificial Intelligence Lab
Course Code: CS192
Contact: (L:T:P) 0: 0: 3
Total Contact Hours: 30
Credit: 1.5

Prerequisites:
Basic Computer Knowledge
Course Objective(s):

The objective of the course is to make the students able to –
O1: Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing.

O2: Formulate a problem by analysing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.

O3: Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.

O4: Build expert systems offering solutions to the challenging problems of Artificial Intelligence.

O5: Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies.

Course Outcomes (COs):
After Successful completion of the 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 **analysing** the performances using proper techniques and tools.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to PROLOG Programming along with the IDE and its Basic Components (3 L)
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 (5 L)
Fibonacci Series, Calculator, Factorial, summation, list length, etc. Using recursive rules.

Module 3: Defining facts and simple queries (4 L)
Writing a knowledge base for family relationships, basic objects.

Module 4: **Rules and inference in Prolog (4 L)**
Creating logical rules and testing inferences.

Module 5: List operations in Prolog (4 L)
Checking membership, concatenation, reverse, max/min of list.

Module 6: Pattern matching and symbolic reasoning (5 L)
Simple examples involving pattern recognition (e.g., shape or name matching, Family Tree design)

Module 7: Expert system simulation (Mini project) (5 L)
Building a mini knowledge-based system (e.g., Animal Classification, Medical diagnosis, etc).

Text book:

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

Course Name: ENGINEERING CHEMISTRY LAB
Course Code: CH 191
Contact: (L:T:P) : 0: 0: 2
Total Contact Hours: 24
Credit: 1
Prerequisites: 10+2

Course Objective

O1: Study the basic principles of pH meter and conductivity meter for different applications
O2: Analysis of water for its various parameters in relation to public health, industries & environment
O3: Learn to synthesis Polymeric materials and drugs
O4: Study the various reactions in homogeneous and heterogeneous medium
O5: Designing of innovative experiments

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

CO-PO mapping:

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

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.
7. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
8. Determination of cell constant and conductance of solutions.
9. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
10. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
11. Drug design and synthesis
12. Synthesis of polymers (Bakelite) for electrical devices and PCBs.
13. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
14. Determination of R_F of any amino acid by thin layer chromatography.
15. Saponification /acid value of any oil.
16. Isolation of graphene from dead dry batteries

Text Books

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

Reference Books

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

IDEA Lab

Workshop

Course Code	**:**	**ME193**
Course Title	**:**	**IDEA Lab Workshop**
Number of Credits	**:**	**(L: 0, T: 0, P: 3)**
Credit	**:**	**1.5**

Course Objectives:

O1: To learn all the skills associated with the tools and inventory associated with the IDEA Lab.

O2: Learn useful mechanical and electronic fabrication processes.

O3: Learn necessary skills to build useful and standalone system/ project with enclosures.

O4: 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 - Tapemeasure, combination square, Vernier calliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping andthreading. 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 Switchingtypes), 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 reverseengineering. 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 testiof 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 scanngeometry 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 hardwasoftware and machined or 3D printed enclosure.

Reference Books:

S. No.	Title
1.	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with LabManual), 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 Learningand Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, KhannaBook Publishing Company, New Delhi.

5.	The Big Book of Maker Skills: Tools & Techniques for Building Great TechProjects. 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 SimonMonk. McGraw Hill. ISBN-13: 978-1259587542
10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). CharlesPlatt. 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 FinishedBoards. 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 andOther Technologies, Kluwer, 2004.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive ManufacturingTechnologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBSPublishers and distributors, 5th Edition,2002.

1st Year 2nd Semester										
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points	
					L	T	P	Total		
A.THEORY										
1	ENGG	Major	ECS201	Introduction to Electrical and Electronics Engineering	3	0	0	3	3	
2	ENGN	Major	CS201	Data Structures and Algorithms	3	0	0	3	3	
3	SCI	Multidisciplinary	PH201	Engineering Physics	3	0	0	3	3	
4	SCI	Multidisciplinary	M201	Engineering Mathematics –II	3	0	0	3	3	
5	HUM	Value Added Course	HU201	Environmental Science	2	0	0	2	2	
6	HUM	Value Added Course	HU202	Indian Knowledge System	1	0	0	1	1	
B. PRACTICAL										
1	ENGG	Major	ECS291	Introduction to Electrical and Electronics Engineering Lab	0	0	3	3	1.5	
2	ENGG	Major	CS292	Data structures and Algorithms Lab	0	0	3	3	1.5	
3	SCI	Skill Enhancement Course	PH291	Engineering Physics Lab	0	0	3	3	1.5	
3	ENGG	Skill Enhancement Course	ME294	Engineering Graphics & Computer Aided Design Lab	0	0	3	3	1.5	
4	HUM	Ability Enhancement Course	HU291	Communication & Presentation Skill	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									30	22.5
TOTAL FIRST YEAR CREDIT										40

Course Name: Introduction to Electrical and Electronics Engineering
Course Code: ECS201
Contact: (L:T:P): 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic Physics and Mathematics, Concept of components of electric circuit.

Course Objective(s):

The objective of the course is to make the students able to –
O1: To expose to the field of Electrical Circuits and Electrical Machine.
O2: To study the basic devices in the field of electronics
O3: To acquire knowledge of using devices to make various electrical and electronic circuits.

Course Outcomes (COs):

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

CO1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO2	Solve simple ac circuits in steady state
CO3	Impart knowledge of Basic Electronics Devices
CO4	Analyze simple electronics circuits

CO-PO Mapping:

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

Course Content:

Module1: Elementary Concepts of Electric Circuits (7L)

DC Circuits: Circuit Components: Review on Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws.
Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state), Superposition Theorem, Maximum Power Transfer Theorem.
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only), Concept of resonance.

Module 2: Electrical Machine (8L)

Construction and Working principle- Separately and Self Excited DC Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Transformers -Construction, Working principle and Applications of Transformers, auto Transformers.

Module 3: Fundamentals of Semiconductor Devices: (6L)

Introduction to Semiconductor: Concept of energy band diagram; Comparison among metal, insulator, semiconductor; Semiconductors-classifications and Fermi energy level; Charge neutrality and Mass-Action law in semiconductor; Current flow in semiconductor due to drift & diffusion process; Einstein relation.

Module 4: PN Junction Diode and its applications: (7L)

Principle of operation; V-I characteristics; principle of avalanche & Zener breakdown; V-I characteristics of Zener diode.

Working principles of half wave and full wave rectifier; Rectifiers-Average output current and voltage, ripple factor, power conversion efficiency; Clipper and Clamper circuit. LC filters; working principle of Zener voltage regulator; Block diagram description of DC power supply;

Module 5: Bipolar Junction Transistors: (4L)

PNP and NPN structures; Principle of operation; Current gains in CE, CB and CC mode; input and output characteristics; biasing & stability analysis- Concept of Fixed Bias, collector to base bias & voltage divider bias.

Module 6: Field Effect Transistors: (4L)

JFET and MOSFET- P Channel & N Channel structures; Principle of operation; CS, CD and CG configurations; Transfer Characteristics and Drain characteristics; FET parameters.

Text books:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II (AC & DC Machines)-B. L Theraja & A.K. Teraja, S. Chand,23rd Edition,1959.
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New Age International (P) Limited Publishers, Seventh Edition,2006.
3. Basic Electrical & Electronics Engineering by J.B. Gupta, S.K. Kataria & Sons,2013.
4. Basic Electrical and Electronics Engineering-I by Abhijit Chakrabarti and Sudip Debnath, McGraw Hill, 2015.

Reference Books:

1. DC Kulshreshtha, "Basic Electrical Engineering", Tata McGrawHill,2010.
2. T.K. Nagsarkar, M.S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hughes, "Electrical and Electronic Technology", Pearson Education".

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:

O1: Gain a strong foundation in data abstraction, data types, and data structures, and understand the importance of structured data organization in solving engineering problems.

O2: 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.

O3: 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.

O4: Evaluate and compare various searching, sorting, and hashing algorithms based on their performance, and choose appropriate methods for optimized data handling.

O5: 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	3	-	3	-	-	-	-	-	-	-	-	-
CO 3	2	2	3	-	3	-	-	-	-	-	-	-	-	-
CO 4	3	3	2	3	3	-	-	-	-	-	-	-	-	-
CO 5	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 Structure 9L

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, Sartaj Sahni, 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: Engineering Physics
Course Code: PH201
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objective(s):

The objective of the course is to make the students able to –
O1: **Provide foundational understanding** of core physical principles such as optics, quantum mechanics, solid-state physics, and statistical mechanics relevant to engineering disciplines.
O2: **Develop the ability** to apply theoretical knowledge of physical sciences in interpreting engineering phenomena and solving problems using scientific reasoning and quantitative analysis.
O3: **Expose students to the working principles** of modern devices and technologies like lasers,
fiber optics, semiconductors, and nanomaterials used in engineering and industrial applications.
O4: **Encourage scientific curiosity and innovation** by connecting physical theories with practical tools and techniques in emerging fields like nanotechnology and quantum systems.
O5: **Understand the role of physics** in interdisciplinary domains for the advancement of science, technology, and sustainable development through real-life engineering contexts.

Course Outcomes (COs):

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

CO1	*Explain* the principles of lasers, fibre optics, and holography and *apply* them in modern optical and communication systems.
CO2	*Identify* different crystal structures and *compute* structural parameters such as Miller indices and packing factors; *distinguish* between metals, semiconductors, and insulators using band theory.
CO3	*Utilize* the principles of quantum theory, wave-particle duality, and Schrödinger equation—to *interpret* fundamental quantum phenomena.
CO4	*Illustrate* the basic concepts of statistical mechanics and e*xamine* their implications on microscopic particle behaviour.
CO5	*Describe* the properties of nanomaterials and display/storage devices and *analyze* their applications in modern technology.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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: Modern Optics (11L)

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: Solid State Physics (5L)

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: Quantum and Statistical Mechanics (14L)

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

3.03 Statistical 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: Physics of Nanomaterials (4L)

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: Storage and display devices (2L)

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

Text book:

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.
4. Quantum Mechanics – S. N. Ghosal
5. Nanotechnology – K. K. Chattopadhyay

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 - II
Course Code: M201
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 Objective(s):
The objective of the course is to make the students able to –
O1: Develop a thorough understanding of ordinary differential equations and their role in modeling real-world systems.
O2: Build competency in applying the Laplace transform as a tool for solving initial value problems and linear differential equations in engineering contexts.
O3: Gain proficiency in numerical techniques for solving mathematical problems where analytical
methods are difficult or impossible.

Course Outcomes (COs):

After Successful completion of the course, students 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 Mapping:

CO	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	-	-	-	-	-	-	-	-	1	2	3	3
CO2	3	2	-	-	-	-	-	-	-	-	1	2	3	3
CO3	3	2	-	-	-	-	-	-	-	-	1	2	2	3
CO4	3	3	1	1	-	-	-	-	-	-	2	3	2	3

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 forp, solvable for y and solvable for xand 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 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. Higher Engineering Mathematics, Grewal, B.S., Khanna Publishers, 36th Edition, 2010.
2. Advanced Engineering Mathematics, 9th Edition, Kreyszig, E., John Wiley & Sons, 2006.

Reference Books:

1. A text book of Engineering Mathematics-I, Guruprasad, S. New age International Publishers.
2. Higher Engineering Mathematics, Ramana, B.V., Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Engineering Mathematics for first year, Veerarajan, T., Tata McGraw-Hill, New Delhi, 2008.
4. A text book of Engineering Mathematics, Bali, N.P. and Goyal, M., Laxmi Publications, Reprint, 2008.
5. Calculus and Analytic geometry, 9th Edition, Thomas, G.B. and Finney, R.L., Pearson, Reprint, 2002.
6. Calculus, Volumes 1 and 2 (2nd Edition), Apostol, M., Wiley Eastern, 1980.
7. Linear Algebra - A Geometric approach, Kumaresan, S., Prentice Hall of India, 2000.

8. Linear Algebra: A Modern Introduction, 2nd Edition, Poole, D., Brooks/Cole, 2005.
9. Schaum's Outline of Matrix Operations, Bronson, R., 1988.
10. Differential and Integral Calculus, Vol. I & Vol. II, Piskunov, N., Mir Publishers, 1969.

Course Name: Environmental Science
Course Code: HU201
Contact Hours: L:2 T:0 P:0
Total Contact Hours: 24
Credits: 2

Prerequisites: 10+2

Course Objective(s)
O1: Realize the importance of environment and its resources.
O2: Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
O3: Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
O4: Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome (COs)
After successful completion of the course, students will be able to

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.

CO – PO Mapping

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

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)

Environmental Auditing, Environmental laws and Protection Acts of India, carbon footprint, Green building practices. *(GRIHA norms)*

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

Course Name: Indian Knowledge System
Course Code: HU202
Contact: 1:0:0
Total Contact Hours: 12
Credit: 01

Prerequisites: A basic knowledge (10+2 level) of Indian history, civilization and culture.

Course Objectives:
The objective of this course is to make the students able to—

O1: understand the extent and aspects of ancient Indian cultural, philosophical and scientific heritage.

O2: explore the philosophical roots of Indian knowledge, the scientific temper and quest for advanced understanding of the universe and deeper knowledge of the self.

O3: identify and describe the Indian scientific and technological tools, techniques and discoveries and assess their significance and continuing relevance.

O4: develop a liberality and open-mindedness of outlook to foster lifelong learning.

O5: acquire the skills to apply traditional knowledge in their everyday lives.

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

CO1	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	discover, enumerate, compare, contrast and categorize the importance of pioneering developments in science and mathematics and evaluate their continuing relevance.
CO 3	analyze, appraise, correlate and describe the ancient Indian heritage in science and technology and examine technological correlations with present-day technological applications.
CO4	discover, assess and describe traditional knowledge in health care, architecture, agriculture and other sectors and to explore the history of traditional Indian art forms.

CO-PO Mapping:

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

Course Content:

Module-1 An overview of Indian Knowledge System (IKS): **(3L)**
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 Salient features of the Indian numeral system: (3L)
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 Indian science and technology heritage: (3L)
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 Traditional Knowledge in Different Sectors: (3L)
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.

Course Name: Introduction to Electrical and Electronics Engineering Laboratory
Course Code: ECS291
Contact: (L:T:P): 0-0-3
Total Contact Hours: 36
Credit: 1.5
Prerequisites: Basic concepts of physics and mathematics.

Course Objective(s):

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

O1: To study the basic laws of circuit
O2: To study the function of dc motor, generator, and transformer.
O3: To examine the characteristics of diodes and transistors
O4: To know the use of semiconductor devices in various electronic circuits.

Course Outcomes (COs):

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

CO1	Analyze a given network by applying KVL and KCL.
CO2	Examine the Operation of DC Motor.
CO3	Examine the Operation of Basic Electronics Devices.
CO4	Design simple electronics circuits.

CO-PO Mapping:

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

Course Content:
List of Experiments: -

1. Familiarization with different passive and active electrical & electronic components.
2. Familiarization with different Electrical & Electronic Instruments.
3. Verification of KVL and KCL.
4. Forward and reversal of DC shunt motor.
5. Speed control of DC shunt motor.
6. Study of the P-N junction diode V-I characteristics (Forward & Reverse Bias).
7. Study of the Characteristics of Zener diode (Forward & Reverse Bias).
8. Study of half wave and full wave rectifier.
9. Study of clipper and clamper circuit.
10. Study of the Input and Output characteristics of BJT in CE mode.

11. Study of transfer and drain characteristics of JFET.
12. Extramural Experiment.

Text books:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II (AC & DC Machines)-B. L Theraja & A.K. Teraja, S. Chand,23rd Edition,1959.
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New Age International (P) Limited Publishers, Seventh Edition,2006.
3. Basic Electrical & Electronics Engineering by J.B. Gupta, S.K. Kataria & Sons,2013.
4. Basic Electrical and Electronics Engineering-I by Abhijit Chakrabarti and Sudip Debnath, McGraw Hill, 2015.

Reference Books:

1. DC Kulshreshtha, "Basic Electrical Engineering", Tata McGrawHill,2010.
2. T.K. Nagsarkar, M.S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hughes, "Electrical and Electronic Technology", Pearson Education".

Course Name: Data Structures and Algorithms Lab
Course Code: CS291
Contact Hours: 0:0:3
Credits: 1.5

Prerequisites:

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

Course Objectives

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

O1: To develop skills in implementing and analyzing data structures using C.
O2: To gain hands-on experience in solving problems using arrays, linked lists, stacks, queues, trees, graphs, and hashing.
O3: 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	Implement and **develop** programs using arrays and linked lists to solve basic linear data structure problems.
CO2	**Construct** and **apply** stack and queue operations using both array and linked list.
CO3	**Design** and **evaluate** non-linear data structures like trees and graphs through traversal, searching, and sorting techniques.
CO4	**Analyze** and **compare** the performance of searching and sorting algorithms with respect to time complexity.
CO5	**Apply** hashing techniques and collision resolution strategies for efficient data access and retrieval.

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:

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, Sartaj Sahni, 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: Engineering Physics Lab
Course Code: PH291
Contact: 0:0:3
Total Contact Hours: 36
Credit: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objective(s):

The objective of the course is to make the students able to –
O1: Become familiar with scientific instruments and measurement techniques used to determine various physical parameters of materials and systems.
O2: Reinforce theoretical concepts learned in classroom physics by performing related practical experiments and observing real-time outcomes.
O3: Develop a systematic and analytical approach to collecting, organizing, and interpreting experimental data for error analysis and validation of physical laws.
O4: Engage in the experimental validation of physical laws through laboratory activities involving classical mechanics, optics, electronics, and quantum phenomena.
O5: Encourage innovation and problem-solving abilities through hands-on investigation of advanced and application-oriented physics experiments, including specially designed extension activities.

Course Outcomes (COs):

After Successful completion of the course, 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.
CO2	*Perform* optical experiments including Newton's Rings, laser diffraction, and optical fiber characterization, and *interpret* the results based on wave optics principles.
CO3	*Investigate* quantum effects such as the photoelectric effect and atomic transitions, and *relate* experimental outcomes to basic quantum principles.
CO4	*Study* the performance of semiconductor and electronic devices like solar cells, LEDs, and LCR circuits, and *investigate* their operational characteristics.
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.

CO-PO Mapping:

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

Course Content:

Module 1: General idea about Measurements and Errors (One Mandatory)

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

Module 2: 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.

Module 3: 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.
10. a. Study of characteristics of solar cell (illumination, areal, spectral)
    b. Study of characteristics of solar cell (I-V characteristics, Power-load characteristics, Power-wavelength characteristics)

Module 4: 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.

Module 5: 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 semiconductor
3. Study of dispersive power of material of a prism.
4. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
5. Determination of the angle of optical rotation of a polar solution using polarimeter.
6. Any other experiment related to the theory.

Text book:

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: ME294
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Objectives:

The objective of the course is to teach detailed engineering drawing and modeling of a component or system for a given dimension or constraints through ample understanding of engineering views, projections and sections. It will help students to acquire the manual drawing techniques as well as computer aided graphics skills, using modern engineering tools to communicate their design effectively in industries.

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
CO2	Understand the concepts of engineering scales, projections, sections.
CO3	Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints
CO4	uce part models; carry out assembly operation and represent a design project work.

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**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	3	-	2	1	-	2	-	1	-	2	3	2
CO2	-	-	3	-	2	1	-	2	-	1	-	2	3	2
CO3	-	-	3	-	3	1	-	2	-	2	-	2	2	2
CO4	-	-	3	-	3	1	-	2	-	2	-	1	2	2

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, Isometric 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 views 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 tpresentation 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 PublishingHouse
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.

Course Name: Communication and Presentation Skill
Course Code: HU291
Contact: (0:0:3)
Total Contact Hours: 36
Credit: 1.5

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: The objectives of the course are to make the students able to-

O1: acquire interpersonal communication skills of listening comprehension and speaking in academic and professional situations.

O2: understand English pronunciation basics and remedy errors.

O3: operate with ease in reading and writing interface in global professional contexts.

O4: deliver professional presentations before a global audience.

O5: develop confidence as a competent communicator.

Course Outcome:

After successful completion of the 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.

CO-PO Mapping:

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

CO 4	-	2	-	-	-	-	-	3	-	3	-	3	2	3
CO 5	-	-	-	-	-	3	-	-	3	3	-	3	2	3

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.
6. Tony Lynch, *Study Listening*. Cambridge: Cambridge University Press, 2004.
7. J. D. O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 2005.
8. Peter Roach. *English Phonetics and Phonology: A Practical Course*. Cambridge: Cambridge University Press, 2000.

Syllabus of 2nd year _R25_ ECS

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS301	Computer Organization and Architecture	3	0	0	3	3
2	ENGG	Major	ECS302	Analog Electronic Circuits	3	0	0	3	3
3	ENGG	Major	ECS303	Digital Electronics Circuits	3	0	0	3	3
4	ENGG	Minor	EC(ECS)301	Electromagnetic Theory and Transmission Line	3	0	0	3	3
5	SCI	Minor	M(ECS)301	Discrete Mathematics	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	ECS391	Computer Organization and Architecture Lab	0	0	0	3	1.5
2	ENGG	Major	ECS392	Analog Circuits Lab	0	0	3	3	1.5
3	ENGG	Major	ECS393	Digital Electronics Lab	0	0	3	3	1.5
4	SCI	Minor	M(ECS)391	Numerical Methods Lab	0	0	0	2	1
5	HUM	Ability Enhancement Course	HU(ECS)391	Technical Seminar Presentation & Group Discussion	0	0	2	2	1
Total of Theory, Practical								28	20.5

Course Name: Computer Organization and Architecture
Course Code: ECS301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objectives: The course objectives of Computer Organization and Architecture are to discuss and make students familiar with the:
O1: Principles and the Implementation of Computer Arithmetic.
O2: Operations of CPU including RTL, ALU, Instruction Cycle, and Buses.
O3: Fundamentals of different Instruction Set Architectures and their relationship to the CPU Design.
O4: Memory System and I/O Organization.
O5: Principles of Multiprocessor Systems.

Course Outcome(s):
On completion of this Subject/Course, the student shall be able to:

CO1: Understand pipelining concepts and parallelism techniques with prior knowledge of stored program methods.
CO2: Evaluate the performance of each type of memory in the hierarchy
CO3: Evaluate different mapping techniques.
CO4: Analyze the SIMD and MIMD architecture and their interconnection techniques.

CO- PO Mapping :

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

Course Content:
Module1 (5L)
Introduction to basic computer architecture, Stored Program Concepts: Von Neumann & Havard Architecture, RISC VS CISC, Amdahl's law, Performance Measure: MIPS, Benchmark Programs (SPECINT, SPECFP).

Module2 (7L)
Different Classification Schemes: Serial Vs. Parallel, Pipelining: Basic concepts, Linear vs. Nonlinear, Static vs. Dynamic, Unifunction vs. Multifunction, Instruction Pipeline, Arithmetic

pipeline, Hazards: Data hazards, control hazards and structural hazards, Techniques for handling hazards.

Module 3 (5L**)**
Pipeline vs. Parallelism, Levels of parallelism, Instruction-Level Parallelism: Basic Concepts, Techniques for Increasing ILP, Superscalar, Super Pipelined and VLIW Processor Architectures, Array and Vector Processors.

Module 4 (11L**)**
Memory Hierarchy: Main Memory, Secondary memory, Cache Memory, Cache coherence and synchronization mechanisms, Mapping Technique in cache memory: Direct, Full Associative and Set Associative, Performance Implementation in Cache Memory, Virtual memory Concepts, page replacement policies.

Module 5 (8L**)**
Multiprocessor architecture Introduction to Parallel Architecture-Different Classification scheme, Performance of Parallel Computers, PRAM model (EREW, CREW, CRCW), Centralized and Shared-memory architecture: synchronization, Interconnection Network(Omega,Baseline,Butterfly, Crossbar).

Text Books:
1. 'Advanced Computer Architecture Parallelism Scalability Programmability', Tata McGraw Hill Education Private Limited ISBN-13: 978-0-07-053070-6 ISBN-10: 0-07-053070-X 2. Hwang & Briggs—Computer Architecture & Parallel Processing, TMH

Reference Books:
Patterson D.A. and Hennessy, J.L. "Computer architecture a quantitative approach", 2nd ed., Morgan Kaufman, 1996
Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
Siegel, H.J., "Interconnection Network for Large Scale parallel Processing", 2nd Ed., Mc GrawHill, 1990
Design and Analysis of Parallel Algorithm-Schim G. Akl

Course Name: Analog Electronic Circuits
Course Code: ECS302
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Concept of basic electronics devices, basic law of circuit analysis

Course Objective(s):

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

O1: To develop understanding of small signal models and frequency response of BJT and FET amplifiers
O2: To explain the principles of feedback and oscillator circuits and their practical applications
O3: To analyze the internal structure, ideal characteristics, and configurations of operational amplifiers.
O4: To apply Op-Amp circuits in signal conditioning and waveform generation applications.
O5**:** To introduce students to large signal amplifier operation and regulated power supply design techniques.

Course Outcomes (COs):

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

CO1	Analyze and interpret small signal behavior of BJT and FET amplifiers including gain, impedance, and bandwidth.
CO2	Examine the effect of feedback in amplifiers and determine conditions for sustained oscillations in oscillator circuits.
CO3	Explain the working of differential amplifiers and ideal and Practical operational amplifiers.
CO4	Design basic Op-Amp based signal processing circuits using amplifiers ,wave shaping circuits as well as Timer circuits
CO5	Evaluate the performance of power amplifiers and design regulated power supplies using regulators.

CO-PO Mapping:

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

CO3	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**
CO4	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**
CO5	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

Course Content:

Module 1: Small Signal Transistor Based Amplifiers (8L)

Small signal amplifiers: Introduction to Analog Integrated Circuits, BJT Modeling - re model, hybrid model of transistors; Example, High frequency model of transistors. FET Small signal analysis – Example.

Transistor Amplifiers: RC coupled amplifier, functions of all circuit components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of multistage amplifier.

Module 2: Feedback Amplifiers & Oscillators (8L)

Feedback Amplifiers: Feedback concept, Voltage series-shunt, current series-shunt feedback Configurations, Effect of negative Feedback. Effect of positive feedback. Oscillators: Barkhausen criterion, Colpitts, Hartley's, Phase shift, Wien Bridge and crystal oscillators - Explanation using equivalent circuit diagram.

Module 3: Operational Amplifier & Applications (12L)

Operational Amplifier: Introduction to Integrated Circuits, Differential Amplifier, CMRR, Constant current source (current mirror etc.), level shifter, Block Diagram of OPAMP, Ideal OPAMP. CMRR, Open & Closed loop Op-Amp based circuits both (positive feedback & Negative feedback).

Applications of Operational Amplifiers: Analog adder, subtractor, integrator, differentiator, comparator, Schmitt Trigger. Instrumentation Amplifier, Log & Anti-log amplifiers, Analog multiplier, Precision Rectifier, voltage to current and current to voltage converter, Applications.

Multivibrator: Concept of Multivibrators - Monostable, Bistable, Astable multivibrators; Monostable and astable operation using 555 timers.

Module 4: Large Signal Amplifiers & Filter-Regulator-Power Supply (8L)

Large signal Amplifiers: Introduction to power amplifiers (Class A, B, AB).

Filter-Regulator-Power Supply: Analysis for DC voltage and ripple voltage with C, L-C and C-L-C filters in Rectifier Circuit – Regulated. Voltage Regulation – percentage regulation- Line regulation-load regulation, Series and Shunt. Fixed output voltage IC

Text book:

1. Millman Halkias – Integrated Electronics, McGraw Hill, 2nd edition,1980
2. Electronic Circuits: Discrete and Integrated – Donald L. Schilling, Charles Belove, McGraw Hill, 3rd Revised Edition, 1979

3. Ramakant A. Gayakwad —Op- Amps and linear Integrated Circuits, Pub: PHI
4. Boylested &Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI, 14th Edition, 2023
5. "Operational Amplifiers and Linear Integrated Circuits" by Robert F. Coughlin, Frederick F. Driscoll, Pearson Education

Reference Books:

1. Rashid-Microelectronic Circuits- Analysis and Design- Thomson (Cengage Learning), Latest Edition 8th edition, 2015
2. Linear Integrated Circuits – D. Roy Choudhury, Shail B. Jain, New Age International, Latest Edition.
3. Analog Integrated Circuits – J. B. Gupta, S.K. Kataria & Sons, Latest Edition

Course Name: Digital Electronic Circuits
Course Code: ECS303
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of basic electronics.

Course Objective(s):

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

O1: gain the basic knowledge of digital logic and digital electronic circuits.

O2: understand basic postulates of Boolean algebra and the correlation between Boolean expressions.

O3: know the basic tools for the analysis and design of combinational circuits and sequential circuits.

O4: acquire the concept of memories, programmable logic devices and digital ICs.

O5: know the conversion techniques of Digital-to-Analog and Analog-to-Digital.

Course Outcomes (COs):

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

CO1	the concept of various number systems and Boolean algebra in digital design.
CO2	analyze and design various cost effective combinational circuits.
CO3	ze and design various cost effective sequential circuits.
CO4	real life complex circuit problems by applying knowledge of digital electronics.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
CO 1	3	3	1	1	1	1	1	1	1	1	1	3	1	1
CO 2	3	3	3	2	1	2	1	2	1	1	1	3	2	1
CO 3	3	3	3	2	1	2	1	2	1	1	1	3	2	1
CO 4	3	3	1	1	1	1	1	1	1	1	1	3	1	1

Course Content:

Module 1: Introduction and Boolean Algebra (11 L)

Introduction to Digital system, Comparison between Analog and Digital system, Logic level, Element of Digital Logic, Functions of Digital logic.

Data and number systems:

Number system: Binary, Octal and Hexadecimal representation and their conversions.

Number Representation: Signed binary number representation with 1's and 2's complement methods, Fixed point - Floating point.

Binary Codes: BCD- Gray code- Excess 3 code- Alpha Numeric codes – Error detecting and correcting codes- properties.

Binary Arithmetic: Addition, subtraction, Multiplication, Division, Addition and subtraction by 1's and 2's complement, BCD addition and subtraction.

Theorems and operations, Boolean expressions and truth tables, Representation in SOP and POS forms Boolean functions; Min-term and Max-term expansions Minimization of logic expressions by algebraic method, K-map method and Quine- McClauskey method.

Various Logic gates- their truth tables and circuits; Design of circuits with universal gates. Exclusive-OR and Exclusive NOR and equivalence operations.

Module 2: Combinational logic Circuits (7L)

Analysis and design of Adder and Subtractor: half and full adder and subtractor, BCD adder and subtractor.

Convertors: BCD to excess-3 and vice versa, Binary to BCD, Gray to binary and vice versa.

Analysis and design of Encoder, Decoder, Magnitude Comparator, Multiplexer, De-Multiplexer and Parity Generator and Checker. Application of combinational logic Circuits.

Module 3: Sequential logic Circuits (10L)

Introduction to sequential circuits.

Basic memory Elements: S-R, J-K, M/S J-K, D and T Flip Flops; Truth table and Excitation table, Conversion of Flip-flop.

Shift Registers: Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register. Design and application of registers.

Counter: Synchronous and Asynchronous counters, Irregular counter design.

Sequential Circuits Design: State diagrams and tables, transition table, excitation table, Examples using flip-flops. Analysis of simple synchronous sequential circuits, construction of state diagram, State Machine-Mealy and Moore machine.

Module 4: Memory devices, Logic families and Data converters (8L)

Memory Systems: RAM: Static RAM and Dynamic RAM, ROM, EPROM, EEPROM

Programmable logic devices: programmable read only memory, programmable logic arrays and programmable array logic, Design using PLA, PAL, PROM

Logic families:

TTL, ECL, MOS and CMOS, their operation and specifications: Logic levels, propagation delay time,

power dissipation fan-out and fan-in, noise margin. Implementation of Logic gate using TTL, MOS

Different types of A/D and D/A:

Conversion techniques: analog-to- digital (successive approximation, Dual slope, flash) and digital-to- analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADCs and DACs (resolution, quantization, significant bits,

Text book:

1. Digital Logic and Computer Design, M. Morris Mano, Prentice-Hall of India (PHI), 1st Edition, 2008.
2. Fundamentals of Digital Circuits, A. Anand Kumar, PHI Learning Pvt. Ltd., 4th Edition, 2016
3. 4. Digital Integrated Circuits, Herbert Taub and Donald L. Schilling, McGraw Hill Education, 2nd Edition

Reference Books:

1. Digital Fundamentals, Thomas L. Floyd, PHI Learning Pvt. Ltd., 9th Edition (India), 2005.
2. Modern Digital Electronics, R. P. Jain & Kishor Sarawadekar, McGraw Hill Education (India) Pvt. Ltd., 5th Edition, 2022
3. Digital Principles and Applications, Albert P. Malvino & Donald P. Leach, McGraw-Hill (Tata McGraw-Hill India), 7th Edition (Indian Special Edition), 2011

Course Name: Electromagnetic Theory and Transmission Line
Course Code: EC(ECS)301
Contact: 3:0:0
Total Contact Hours: 3
Credit: 36

Prerequisites: Physics, Concept of vector calculus

Course Objective(s):

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

O1: acquire knowledge of Electromagnetic field theory that makes the student get a theoretical foundation to be able in the future to design emission, propagation and reception of electromagnetic wave systems.

O2: identify, formulate and solve the problems related to fields and electromagnetic wave propagation in a multidimensional frame.

O3: understand the basic concepts of electric and magnetic fields.

O4: provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.

O5: understand the concept of conductors, dielectrics, inductance and Capacitance, Gain knowledge on the nature of magnetic materials.

O6: understand the concept of static and time varying fields.

Course Outcomes (COs):

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

CO1	Understand and Interpret the physical significance of gradient, divergence, and curl in vector calculus and comprehend the use of orthogonal coordinate systems.
CO2	Apply the concepts of electrostatic and magneto static fields and different associated laws in different cases and mediums and explain the physical significance of Maxwell's equations for static fields.
CO3	Solve problems related to time-varying electromagnetic fields and analyse the correlation between the Poynting vector and Poynting theorem.
CO4	Evaluate and explain electromagnetic wave propagation in three-dimensional media such as free space, dielectrics, conductors and apply them to transmission lines and waveguides.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**3**	**3**

CO2	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**3**
CO3	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**3**
CO4	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**2**

Course Content:

Module 1 : Vector Calculus and Coordinate Systems (6L)

Introduction to the Electromagnetic Theory, Vector calculus – orthogonal Coordinate Systems,Transformations of coordinate systems; Differential length, area and volume in different coordinate systems.

Del operator; Gradient, Divergence, Curl – their physical interpretations; Divergence Theorem, Stoke's Theorem, Laplacian operator.

Module 2: Electrostatics and Magnetostatics (10L)

Coulomb's law in vector form, electric field intensity, charge distribution.; Gauss' law, Applications of Gauss's Law, flux density and electric field intensity.Energy density in electrostatic field, Current Densities, Conductors. Equation of continuity, Poisson's & Laplace's equations, Uniqueness theoremConcept of Polarization, the relation between D, E and P, Polarizability

Lorentz force (concept in Hall effect), Biot-Savart's law, Ampere's law and its applications in different cases, Relation between J & H, Vector magnetic Potential. Maxwell's equations for static field. Study of different Applications on static fields using MATLAB Programming. Magnetic torque and moments, Magnetization in material, Electric and Magnetic boundarycondition, Concept of Magnetic energy

Module 3: Time-varying field and Maxwell's equations (11L)

Faraday's law & Lenz's law, Transformer and motional emf, Displacement Current, J C – J D Relation, Maxwell's equations for Timevarying field and its physical significances, Time harmonic fields, Maxwell's equations for time harmonic field, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Free space, good conductor, skin effect and skin depth. Poynting Theorem, Power flow, Poynting vector. Wave polarizations.

Module 4: Transmission Lines (9L)

Transmission Lines: Concept of Lump parameters and Distributed parameters, Line Parameters, Transmission line equations and solutions, Physical significance of the solutions. Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation, group velocity, phase velocity; Distortion-less Line, Reflection and

Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith chart, Load Matching Techniques. Transmission line at microwave frequency; brief of rectangular waveguide. Basics of Antenna

Text book:

1. Principles of Electromagnetics, Mathew N.O. Sadiku, Oxford University Press, 5th Edition, 2009
2. Engineering Electromagnetics, W.H. Hayt& J.A. Buck, Tata McGraw-Hill (McGraw-Hill Higher Education), 7th Edition, 2006
3. Theory and Problems of Electromagnetics, Joseph A. Edminister (Schaum's Outline), McGraw-Hill, 2nd Edition, 1993
4. Electromagnetic Theory & Electrodynamics, Satya Prakash, KedarnathRamnath Publication, 11th Edition, 2018

Reference Books:

1. Electromagnetic Theory & Electrodynamics, Satya Prakash, Kedarnath Ramnath Publication, 11th Edition, 2018
2. Electromagnetic Field Theory, Syed Hasan Saeed &FaizanArif Khan, S.K. Kataria& Sons, 2nd Edition, 2014
3. Electromagnetics Field Theory & Transmission Lines**,** G.S.N. Raju, Pearson India, 1st Edition, 2006

Course Name: Discrete Mathematics
Course Code: M(ECS)301
Contact: 3 :0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:
The students to whom this course will be offered should have a fundamental understanding of (10+2) standard set theory, algebra, and logic, along with the ability to follow formal mathematical notation and basic proof techniques.

Course Objective(s):
The objective of the course is to make the students able to –

O1: Develop a conceptual understanding of set theory, relations, lattices, combinatorics, and propositional logic to model discrete mathematical systems.
O2: Gain proficiency in applying number theory and algebraic structures—such as groups, rings, and fields—for logical reasoning and problem-solving in computing contexts.
O3: Build the skill to tackle problems involving graphs, trees, and recurrence relations using algorithmic approaches and generating functions.

Course Outcomes (COs):

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

CO1	apply fundamental concepts of set theory, relations, lattices, and combinatorics to model structured and logical problems in computing.
CO2	apply number theoretic techniques and algebraic structures such as groups and rings in the design and analysis of secure and efficient computational systems.
CO3	analyze logical propositions using propositional logic and truth tables to draw valid conclusions and verify the consistency of logical systems.
CO4	analyze the structural properties and relationships within computational and engineering problems using graph theory and tree-based algorithms.

CO-PO Mapping:

CO	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	-	-	-	-	-	-	-	-	1	1	2	1
CO2	3	2	-	-	-	-	-	-	-	-	1	2	1	3
CO3	3	3	1	1	-	-	-	-	-	-	2	2	2	1
CO4	3	3	1	1	-	-	-	-	-	-	2	2	1	3

Course Content:

Module-I: Set Theory (11L)

Posets& Lattices:

Relation: Types of Relations, Properties of Binary Relation, Equivalence Relation, Partial Ordering Relation and Posets, Lattices.

Combinatorics:

Principle of Inclusion Exclusion, Pigeon Hole Principle.

Generating Functions and Recurrence Relations:

Generating functions, Recurrence relations: Formulation of different counting problems in terms of recurrence relations, Solution of recurrence relations with constant coefficients by Generating functions method.

Module-II: Propositional Logic (5L)

Basics of Boolean Logic, Idea of Propositional Logic, well-formed formula, Logical Connectives, Truth tables, Tautology, Contradiction, Algebra of proposition, Logical Equivalence, Normal Forms: Disjunctive Normal Forms (DNF) and Conjunctive Normal Forms (CNF).

Module-III: Number Theory (4L)

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

Module-IV: Algebraic Structures (8L)

Concepts of Groups, Subgroups and Order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation Groups and Symmetric Groups, Definition of Ring and Field.

Module-V: Graph Theory (8L)

Graph theory, Theorems (statement only), Digraphs, Weighted Graph, Walk, Path, Circuit, Connected and Disconnected Graph, Bipartite Graph, Complement of a Graph, Regular Graph, Complete Graph, Adjacency and Incidence matrices of a graph (digraph), Dijkstra's algorithm.

Tree, Binary Tree, Theorems on Tree (statement only), Spanning Tree, Minimal Spanning Tree, Kruskal's Algorithm, Prim's Algorithm.

Text Books:

1. Graph Theory with Applications to Engineering and Computer Science, Deo, N., Prentice Hall.
2. Higher Algebra: Abstract and Linear, Mapa, S. K., Levant, 2011.
3. Discrete Mathematics, Chakraborty, S. K. and Sarkar,B. K., OXFORD University Press.
4. Discrete Mathematics and its Applications, Rosen, K. H., Tata McGraw – Hill.

Reference Books:

1. Higher Engineering Mathematics, Grewal, B. S., Khanna Pub.
2. Advanced Engineering Mathematics, Kreyzig, E., John Wiley and Sons.
3. Discrete Mathematics, Sharma, J.K.,Macmillan.
4. Elements of Discrete Mathematics A Computer OrientedApproach, 3rd Edition, Liu, C. L. and Mohapatra, D. P.,Tata McGraw – Hill.
5. Discrete Mathematical Structure and It's Application to Computer Science, TMG Edition, Tremblay, J. P. and Manohar, R.,TataMcgraw-Hill.

Course Name: Computer Organization and Architecture Lab
Course Code: ECS391
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Course Outcomes:

On completion of this course students will be able to:

CO1	design the basic gates.
CO2	verify the truth table.
CO3	implement different mapping techniques.
CO4	design circuit using Xilinx tools.

CO-PO Mapping:

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

List of Experiment:

1. Implement different types of Basic gates and simulate for truth table verification.
2. Implement half adder circuit and simulate for truth table verification.
3. Implement full adder circuit and simulate for truth table verification.
4. Implement half subtractor circuit and simulate for truth table verification.
5. Implement full subtractor circuit and simulate for truth table verification.
6. Implement Multiplexer, Demultiplexer circuit and simulate for truth table verification.
7. Implement Encoder, Decoder circuit and simulate for truth table verification.
8. Implement different types of flip flop and simulate for truth table verification.
9. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
10. Implement ALU and simulate the result.
11. Implement RAM chip and simulate the result.
12. Innovative Experiments.

Course Name: Analog Circuits Lab
Course Code: ECS392
Contact: 0:0:3
Credits: 1.5

Prerequisites: Concept of basic electronics devices, concept of circuit theory.

Course Objective(s):

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

O1: To understand the characteristics of analog electronic components
O2: To construct and analyze basic analog circuits such as rectifiers, amplifiers, filters, and regulators.
O3: To design and verify the operation of Op-Amp-based analog signal processing circuits.
O4: To explore waveform generation techniques using analog components like Op-Amps and 555 timers.
O5: To promote innovative thinking and problem-solving by encouraging circuit design beyond standard experiments.

Course Outcomes (Cos):

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

CO1	analyze the ripple and regulation characteristics of rectifier circuits with and without filters.
CO2	Construct and evaluate the performance of amplifier and waveform generation circuits using Op-Amps and transistors.
CO3	Design and implement Op-Amp-based applications such as adders, subtractor, integrators, and differentiators.
CO4	Configure timer IC (NE555) and Op-Amps for waveform generation and comparator applications.
CO5	Develop and demonstrate innovative analog circuits beyond standard experiments using acquired knowledge.

CO-PO Mapping:

CO	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	1	1	1	1	1	1	1	1	1	1	2	1
CO2	2	1	3	1	1	1	1	1	1	1	1	1	2	1
CO3	2	2	1	3	1	1	1	1	1	1	1	1	3	2
CO4	2	2	3	1	1	1	1	1	1	1	1	1	2	2
CO5	2	2	1	3	1	1	1	1	1	1	1	1	3	2

Course Content:

List of Experiment:

1. Study of ripple and regulation characteristics of full wave rectifier with and without capacitor filter

2. Construction of a R-C coupled amplifier & study of its input impedance, output impedance and frequency response

3. Design and testing of timer circuit using NE555 & design monostable & astable multivibrator

4. Study a linear voltage regulator using regulator IC chip.

5. Design and testing of analog adder and subtractor using Operational Amplifier.

6. Design and testing of integrator and differentiator using Operational Amplifier.

7. Construction of precision rectifier using Operational Amplifier.

8. Construction of a simple function generator using Operational Amplifier.

9. Construction of a Schmitt trigger circuit using Operational Amplifier.

10. Design and testing of Wien bridge oscillator.

11. Study and analysis of Instrumentation Amplifier.

12. Innovative Experiment on Design of Solar-Powered Battery Charging Circuit with Op-Amp Control/ Temperature-Controlled Fan using Op-Amp and Thermistor/ Biomedical Signal Pre-Amplifier/ Design of Adaptive Gain Amplifier using VCVS (Voltage-Controlled Voltage Source) using hardware/Simulation.

Text book:

1. Integrated Electronics, Jacob Millman, Christos C. Halkias, McGraw Hill, 2nd Edition, 2001
2. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Learning, 4th Edition, 2000
3. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky, Pearson, 11th Edition, 2013
4. Electronic Circuits: Discrete and Integrated, Donald L. Schilling, Charles Belove, McGraw Hill, 3rd Edition, 1989

Reference Books:

1. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, Pearson Education, 6th Edition, 2000
2. Linear Integrated Circuits, D. Roy Choudhury, Shail B. Jain, New Age International Publishers, 4th Edition, 2010
3. Analog Integrated Circuits, J. B. Gupta, S. K. Kataria & Sons, Latest Edition, 2014

Course Name: Digital Electronics Lab
Course Code: ECS393
Contact: 0:0:3
Credits: 1.5

Prerequisites: Concept of basic electronics devices, concept of circuit theory.

Course Objective(s):

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

O1: realize and implement basic logic gates and combinational logic circuits using universal gates.
O2: design and analyze various code converters, parity generators, comparators, decoders, and multiplexers.
O3: develop and verify arithmetic circuits and display drivers using logic gates and multiplexers.
O4: construct and examine the behavior of flip-flops, registers, and counters in both synchronous and asynchronous modes.
O5: apply digital logic design techniques creatively through innovative experiments and irregular sequence counters.

Course Outcomes (COs):

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

CO1	Implement basic logic gates and combinational logic circuits using universal gates and verify their functionality.
CO2	Design and analyze code converters, parity generators, comparators, decoders, and multiplexers for digital applications.
CO3	Construct arithmetic circuits, flip-flops, registers, and counters, and demonstrate their working in sequential logic systems.
CO4	Develop and implement innovative digital circuits and irregular counters to solve real-time digital design problems.

CO-PO Mapping:

CO	PO 1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	2	2	2	3	1	1	1	1	1	1	1	3	3	2
CO2	2	2	3	1	1	1	1	1	1	1	1	2	2	2	2
CO3	2	2	3	2	1	1	1	1	1	1	1	1	1	2	2
CO4	3	3	2	2	1	1	1	1	2	1	1	2	1	2	1

List of Experiments:

1. Realization of basic gates using Universal logic gates
2. Code conversion circuits- BCD to Excess-3 & vice-versa
3. 4-bit parity generator & comparator circuits
4. Construction of simple Decoder & Multiplexer circuits using logic gates
5. Design of combinational circuit for BCD to decimal conversion to drive 7segment display using multiplexer
6. Construction of simple arithmetic circuits-Adder, Subtractor.
7. Realization of R-S, J-K & D flip-flops using Universal logic gates.
8. Realization of Universal Register using J-K flip-flops & logic gates.
9. Realization of Universal Register using multiplexer & flip-flops.
10. Realization of Asynchronous and Synchronous Up/Down counter.
11. Design of Sequential Counter with irregular sequences.
12. Realization of Ring counters.
13. Innovative Experiment.

Text book:

1. Digital Logic and Computer Design, M. Morris Mano, Prentice-Hall of India (PHI), 1st Edition, 2008.
2. Fundamentals of Digital Circuits, A. Anand Kumar, PHI Learning Pvt. Ltd., 4th Edition, 2016
3. 4. Digital Integrated Circuits, Herbert Taub and Donald L. Schilling, McGraw Hill Education, 2nd Edition

Reference Books:

1. Digital Fundamentals, Thomas L. Floyd, PHI Learning Pvt. Ltd., 9th Edition (India), 2005.
2. Modern Digital Electronics, R. P. Jain & Kishor Sarawadekar, McGraw Hill Education (India) Pvt. Ltd., 5th Edition, 2022
3. Digital Principles and Applications, Albert P. Malvino & Donald P. Leach, McGraw-Hill (Tata McGraw-Hill India), 7th Edition (Indian Special Edition), 2011

Course Name: Numerical Methods Lab
Course Code: M(ECS)391
Contact: 0:0:2
Credits: 1

Prerequisite: The students have the concept of any introductory course on programming language (C/ MATLAB).

Course Objective: The purpose of this course is to provide basic programming skills for solving the problems in numerical methods.

Course Outcomes (COs):

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

CO1	Apply the programming skills to solve the problems using numerical approaches.
CO2	Analyze and interpret the results of numerical approaches using the command.
CO3	Judge the multiple numerical approaches in terms of their accuracy level.
CO4	Design and develop effective programs for numerical approaches to solve the engineering problems.

CO-PO Mapping:

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

Course Content:

List of Experiments:

1. **Assignments on interpolation:**
   Newton's forward and backward interpolation, Lagrange's interpolation, and Newton's divided difference interpolation.
2. **Assignments on numerical integration:**
   Trapezoidal rule, Simpson's 1/3 rule, and Weddle's rule.

3. **Assignments on numerical solution of systems of linear equations:**
   Gauss elimination method, LU factorization method, and Gauss-Seidel method.
4. **Assignments on numerical solution of algebraic equations:**
   Bisection method, Regula-Falsi method, Secant method, and Newton-Raphson method.
5. **Assignments on numerical solution of ordinary differential equations:**
   Euler's method, modified Euler's method, and Runge-Kutta methods.
6. **Implementation of numerical methods using C/C++ and commercial software packages such as MATLAB or Python.**

Text Books:

1. Scarborough, J. B., Numerical Mathematical Analysis, Oxford University Press.
2. Kanetkar, Y., Let us C, BPB Publication,15 th Edition
3. Gupta, S. and Dey, S., Numerical Methods, Mc. Grawhill Education Pvt. Ltd.
4. Balagurusamy, E., Numerical Methods, Scitech. TMH.

Reference Books:

1. Xavier, C., C Language and Numerical Methods, New age International Publisher.
2. Venugopal, K. R. and Prasad, S.R., Mastering-C, TMH, 2 nd Edition.
3. Guha, S. and Srivastava, R. Numerical Methods, Oxford Universities Press.

Course Name: Technical Seminar Presentation and Group Discussion
Course Code: HU(ECS)391
Contact: 0:0:2
Credit: 1

Prerequisite: Basic spoken English skills and presentation skills.

Course Outcomes (COs):

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

CO1	Identify, define, apply workplace interpersonal communication modalities in an effective manner.
CO2	Employ, infer, relate group behavioral and personal interview skills.
CO3	Organize, differentiate, employ reading proficiency skills.
CO4	Identify, classify, organize and relate question types and aptitude test patterns in placement tests.

CO-PO Mapping:

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

Course Content

Module 1: Fundamentals of Technical Communication

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

Module 2: Verbal ability

1. Reading skill Development
2. Enhancing reading speed and vocabulary enhancement through intensive practice of placement test-based reading passages.

Module 3: Presentation Strategy

Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module 4: Group Discussion and Personal Interview

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

Text Books

1. Technical Communication , 3rd edition. New Delhi: Oxford University Press, 2015.
2. Cambridge English for Engineering, Mark Ibbotson. Cambridge: Cambridge University Press, 2008.

3. Professional English in Use: Engineering. Mark Ibbotson. Cambridge: Cambridge UP, 2009.

Reference Books

1. Business Communication: Connecting in a Digital World. Lesikar. New Delhi: Tata McGraw-Hill, 2014.
2. Writing Reports. John Seeley. Oxford: Oxford University Press, 2002.
3. E-writing: 21st Century Tools for Effective Communication. Diana Booher. Macmillan, 2007.
4. Practical English Usage. Michael Swan. Oxford: OUP, 1980.

2nd Year 4th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	ECS401	Microprocessor and Microcontrollers	3	0	0	3	3
2	ENGG	Major	ECS402	Operating Systems	3	0	0	3	3
3	ENGG	Major	ECS403	Database Management Systems	3	0	0	3	3
4	ENGG	Minor	EC(ECS)401	Communication Engineering	3	0	0	3	3
5	ENGG	Minor	CS(ECS)401	Formal Language and Automata theory	3	0	0	3	3
6	HUM	Ability Enhancement Course	CS(ECS)402	Computing with Python	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	ECS491	Microprocessor and Microcontrollers Lab	0	0	3	3	1.5
2	ENGG	Major	ECS492	Operating Systems Lab	0	0	3	3	1.5
3	ENGG	Major	ECS493	Database Management Systems Lab	0	0	3	3	1.5
4	ENGG	Minor	EC(ECS)491	Communication Engineering Lab	0	0	2	2	1
5	HUM	Ability Enhancement Course	HU(ECS)491	Soft skill & Aptitude	0	0	2	2	1
Total of Theory, Practical								26	24.5

Course Name: Microprocessors and Microcontrollers
Course Code: ECS401
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Digital Electronics, basic programming concept

Course Objective(s):

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

O1: understand the architectures of 8085 microprocessors and 8051 microcontrollers.

O2: familiarize with the assembly level programming technique.

O3: understand interfacing of 8-bit microprocessor /microcontroller with memory and peripheral ICs involved in system design.

O4: acquire the knowledge of I/O interfacing with 8051.

Course Outcomes (COs):

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

CO1	Apply the knowledge of internal architecture of 8085 microprocessor to explain the functionality of its components.
CO2	Apply the knowledge of internal architecture of 8051 microcontroller to explain the functionality of its components.
CO3	Develop assembly level programs using instruction set for different application.
CO4	Construct interfacing circuits for some real time applications.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
CO1	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO2	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**3**	**2**	**1**
CO3	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**3**	**2**	**1**
CO4	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Course Content:

Module 1: 8085 Microprocessor Architecture and Interfacing (12 L)

Introduction to microprocessors, Evolution of microprocessors, The 8085 Internal architecture, Instruction set and Assembly Language Programming. Addressing Modes. Timing diagrams, Interfacing memory, Interfacing I/O devices, Stack and Subroutine. Programmable peripheral Interface (PPI) – Intel 8255.

Module 2: Microcontroller Architecture: Intel 8051 (12L)

Microcontroller 8051 - Organization and Architecture, pin configuration, memory Organization, I/O ports functions, External Memory interfacing. I/O Ports, Timers-Counters, Serial Communication and Interrupts.

Module 3: Assembly Language Programming with 8051 (8L)

Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching –

Unconditional and Conditional, Calls & Subroutines. Assembly language program.

Module 4: I/O interfacing with 8051

LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface.

Text book:

1. Microprocessor Architecture, Programming and Applications with 8085/8085A, Ramesh S. Gaonkar, Wiley Eastern Ltd., 1st Edition, 1989
2. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi & Janice Gillispie Mazidi, Pearson Education Inc., 2nd Edition, 2006
3. The 8051 Microcontroller: Architecture, Programming and Applications, Kenneth J. Ayala, West Publishing Company, 1st Edition, 1991

Reference Books:

4. Fundamentals of Microprocessor and Microcontrollers, B. Ram, Dhanpat Rai Publications, Revised Edition, 2011
5. The 8085/8085A Microprocessor Book, Intel Corporation, Wiley Interscience Publications, 1st Edition, 1980
6. Microcontrollers: Theory and Applications, Ajay V. Deshmukh, Tata McGraw-Hill, 1st Edition, 2005

Course Name: Operating Systems
Course Code: ECS402
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36

Prerequisites:

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

Course Objective(s):

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

O1. To understand the fundamental concepts, structure, and functionalities of operating systems, including process, memory, file, and I/O management.
O2. To explore process synchronization, scheduling, inter-process communication, and deadlock handling for efficient resource utilization and system performance.
O3. To analyse and apply various memory allocation, disk scheduling, and file system techniques used in modern operating systems.

Course Outcomes (COs):

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

CO1	Describe how computing resources such as CPU, memory and I/O are managed by the operating system.
CO2	Analyze kernel and user mode in an operating system.
CO3	Solve different CPU scheduling problem to achieve specific scheduling criteria.
CO4	Apply the knowledge of process management, synchronization, deadlock to solve basic problems.
CO5	Evaluate and report appropriate design choices when solving real-world problems.

CO-PO Mapping:

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

Course Content

Module 1: (3L)

Functionalities of Operating System, Evolution of Operating System.

Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security.

Module 2: (11L)

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.

Threads: overview, benefits of threads, user and kernel level threads, Thread models.

CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling).

Module 3: (11L)

Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors.

Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Module 4: (6L)

Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB.

Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model.

Module 5: (5L)

Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK etc), disk reliability, disk formatting, boot block, bad blocks.

File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector

I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O.

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: Database Management System
Course Code: ECS403
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite:

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

Course Objective(s):

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

O1: learn data models, conceptualize and depict a database system
O2: design system using E-R diagram.
O3: learn SQL and relational database design.
O4: understand the internal storage structures using different file and indexing techniques.
O5: know the concepts of transaction processing, concurrency control techniques and recovery procedure

Course Outcomes (COs):

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

CO1	Apply the fundamental concepts of DBMS, including data models, schema architecture, and database languages, to real-world system requirements.
CO2	Analyze Entity-Relationship (E-R) diagrams and relational schemas to identify keys, constraints, and normalization requirements..
CO3	Evaluate query performance and transaction handling strategies using relational algebra, SQL, indexing, and concurrency control techniques.
CO4	Design and create a normalized relational database using SQL, PL/SQL, and modern tools such as NoSQL or cloud-based systems to meet organizational needs.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO 8	PO 9	PO1 0	PO 11	PS O1	PS O2	PS O3
CO 1	2	2	2	2	3	2	1	1	2	2	3	3	3	3
CO 2	2	3	3	3	3	1	1	1	2	2	3	3	2	2
CO 3	3	3	2	3	3	2	2	2	3	3	3	2	1	1
CO 4	3	3	2	2	2	1	1	1	1	1	2	3	2	2

Course Contents

Module 1: Introduction (4L)

Concept & Overview of Database Systems, Applications of Databases in Industry (e-commerce, banking, mobile apps)
Types of Databases: Relational, NoSQL, Cloud-based
Roles: Database Users & Administrators
Three Schema Architecture of DBMS

Module 2: Data Modeling and Relational Database Model (6L)

Basic Concepts of Data Modelling
Entity-Relationship (E-R) Model: Design, Keys, Constraints, Extended E-R Features, Weak Entities, Case Study: ER Model for Online Shopping, Mapping E-R Model to Relational Model,
Relational Model Concepts: Tables, Keys, Constraints
Relational Algebra: Basic Operations and Use Cases

Module 3: SQL and Application Development (6L)

SQL Basics: DDL, DML, DCL
Queries: SELECT, JOINs, Subqueries, Aggregate Functions
Constraints: Domain, Key, Referential Integrity, Views, Triggers
Stored Procedures Concepts of Transactions in SQL
Database Security Basics
Hands-on Practice with MySQL

Module 4: Relational Database Design (6L)

Functional Dependencies
Database Design Issues and Anomalies
Normal Forms: 1NF, 2NF, 3NF, BCNF
Higher Normal Forms: 4NF, 5NF (basic overview)
Decomposition and Dependency Preservation
Case Study: Designing a Normalized Database for Library Management

Module 5: Internals of RDBMS, File Organization & Index Structures (10L)

Physical Storage Structures
Introduction to Query Optimization: Rule based and Cost based optimization
Join Algorithms: Nested Loop, Hash Join (basic idea)
Basics of Transaction Processing
Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.
File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single Level Index (primary, secondary, clustering), Multilevel Indexes**.**

Module 6: Introduction to NoSQL and Cloud Databases (4L)

Need for NoSQL Databases
Types of NoSQL: Key-Value, Document (MongoDB basics)
Differences between SQL and NoSQL
Introduction to Cloud Databases (Google Cloud, AWS RDS)
Simple Application Using MongoDB or Firebase (overview only)

Text Books:

1. Database System Concepts, Henry F. Korth and Abraham Silberschatz (with S. Sudarshan), McGraw-Hill, 7th Edition, 2019.
2. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, Addison-Wesley (Pearson), 7th Edition, 2015.
3. Introduction to Database Management, C. J. Date, Addison-Wesley, Volumes I–III, 7th Edition, 2000.

Reference Books:

1. Advanced Database Management System, V. K. Jain, Cyber-Tech Publications, 1st Edition**,** 2003.
2. Fundamentals of Database Systems**,** Ramez Elmasri and Shamkant B. Navathe, Addison-Wesley (Pearson),7th Edition, 2015.
3. Database Management Systems, Arun K. Majumdar and Pritimoy Bhattacharya, Tata McGraw-Hill, 1st Edition**,** 2017.

Course Name: Communication Engineering
Course Code: EC(ECS)401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Basic concept of Signals and Systems, Analog and digital electronic circuits

Course Objective(s):
The objective of the course is to make the students able to –

O1. Understand the fundamental components and structure of analog and digital communication systems.
O2. Gain in-depth knowledge of various modulation techniques, both analog and digital along with their generation and demodulation
O3. Learn the principles of sampling, quantization, and pulse modulation, and understand their role in digital communication systems.
O4. Explore digital transmission techniques and analysis of signal quality.
O5**.** Introduce the basics of information theory and coding to ensure reliable data communication.

Course Outcomes (COs):

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

CO1	Identify and describe the basic elements of communication systems and the effect of noise and SNR on system performance.
CO2	Analyze and compare different analog and digital modulation schemes used in communication systems.
CO3	Apply sampling theorem, perform A/D and D/A conversions, and analyze the impact of quantization and encoding.
CO4	Interpret and implement digital transmission techniques, including line coding and matched filtering, to minimize inter-symbol interference.
CO5	Demonstrate understanding of coding theory fundamentals such as entropy, information rate, and error control coding.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**1**	**3**	**1**
CO3	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**2**
CO4	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**3**	**2**
CO5	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

Course Content:

Module 1: Elements of communication system (10L)

Basic elements of a communication system, Concept of transmitter and receiver, origin of noise and its effects in communication system, Concept and effects of SNR and its importance in system design. Linear (AM) modulation, Generation and demodulation of AM wave. Parameter Analysis related to AM, related numerical. Concept of DSBSC, SSBSC and brief discussion of VSBSC. Concept of QAM. Basic principle of nonlinear (FM, PM) modulation and parameter analysis. Generation and demodulation of FM waves.

Module 2: Sampling and Pulse Modulation techniques (8L)

Sampling theorem, sampling rate, related numerical. Types-Impulse sampling, natural & flat-top sampling, reconstruction of signal from samples, Concept of Aliasing and anti-aliasing filter. Quantization noise, Uniform quantization, non-uniform quantization, A-law and μ-law. Analysis of different A/D and D/A conversion with respect to concept of Bit rate, Baud rate, M-ary encoding. Analog pulse modulation-PAM, PWM, PPM.

Fundamentals of PCM, Block diagram of PCM, Linear and non-linear PCM basic concept of Delta modulation, Adaptive delta modulation. Introduction to DPCM. Types of multiplexing: TDM, FDM block diagram and operation.

Module 3: Digital Transmission (8L)

Basic concept of Digital communication, comparative study of digital communication and analog communication. Encoding, coding efficiency. Line coding & its desirable properties, Different types of line coding: NRZ & RZ, AMI, Manchester coding and their spectra. Base band pulse transmission, optimum filter, Matched filter and correlation filter, Inter Symbol Interference (ISI), Power Spectral Density (PSD) Eye pattern, Signal power in binary digital signal.

Module 4: Digital carrier modulation & demodulation technique (6L)

Introduction to the digital modulation techniques- ASK. FSK, PSK, BPSK, QPSK, M-ary PSK and their comparisons. Basic concept of spread spectrum modulation and CDMA

Module 5: Introduction to coding theory (4L)

Introduction, Measurement of Information and its unit, Entropy, Mutual information, Information rate, Basic principle of error control & error correction coding.

Text book:

1. Modern Digital and Analog Communication Systems, B.P. Lathi, Oxford University Press, 4th Edition, 2010
2. Communication Systems (Analog and Digital), Dr. Sanjay Sharma, S.K. Kataria & Sons, Latest Edition, 2022
3. Analog communication system, P. Chakrabarty, Dhanpat Rai & Co.
4. Principle of digital communication, P. Chakrabarty, Dhanpat Rai & Co.
5. Communication Systems, Simon Haykin, Wiley India Pvt. Ltd., 5th Edition, 2013

Reference Books:

1. Digital and Analog communication Systems, Leon W Couch II, Pearson, Education Asia.
2. An Introduction to Analog and Digital communication, Simon Haykin, Wiley India.
3. Principles of Communication Systems, Herbert Taub and Donald Schilling, McGraw-Hill Education, 3rd Edition, 2007
4. Electronic Communication Systems, George Kennedy & Bernard Davis, McGraw-Hill Education, 4th Edition,1999.

Course Name: Formal Language and Automata Theory
Course Code: CS(ECS)401
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Digital Logic
2. Computer organization
3. Computer Fundamentals

Course Outcome(s):

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

CO1	acquire the knowledge of the basics of state machines with or without output and its different classifications
CO2	understand synchronous sequential circuits as the foundation of digital system.
CO3	apply techniques of designing grammars and recognizers for several programming languages.
CO4	analyze Turing's Hypothesis as a foreword to algorithms.
CO5	perceive the power and limitation of a computer, and take decisions on computability.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO3	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO5	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**

Course Contents:

Module-1: (9L)

Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram,

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.

NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion.

Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill- NerodeTheorem Limitations of FSM, Application of Finite Automata.

Module-2: (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.
Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy Machine**.**
Minimization of incompletely specified machine−Merger Graph, Merger Table, Compatibility Graph
Lossless and Lossy Machine – Testing Table, Testing Graph **.**

Module-3: (5L)
Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden's Theorem statement and proof.
Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA.
Constructing Regular Expression for a given Finite Automata.
Pumping Lemma of Regular Sets. Closure properties of regular sets**.**

Module-4: (9L)
Grammar Formalism-Context Free Grammars, Derivation trees, sentential forms. Rightmost and leftmost derivation of strings, Parse Tree, Ambiguity in context free grammars.
Minimization of Context Free Grammars.**,**Removal of null and unit production
Chomsky normal form and Greibach normal form.
Pumping Lemma for Context Free Languages.

Enumeration of properties of CFL, Closure property of CFL, Ogden's lemma &itsapplications**,**
Regular grammars−right linear and left linear grammars
Pushdown Automata: Pushdown automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA
Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence.
Equivalence of CFL and PDA, inter-conversion.

Module-5: (5L)
Turing Machine: Turing Machine, definition, model
Design of TM, Computable functions **,**Church's hypothesis, counter machine
Types of Turing machines
Universal Turing Machine, Halting problem

Textbook:
1."Introduction to Automata Theory Language and Computation", Hopcroft H.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

Course Name: Computing with Python
Course Code: CS(ECS)402
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36

Course Objective(s):

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

O1: Describe the core syntax and semantics of Python programming language.
O2: Discover the need for working with the strings and functions.
O3: Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
O4: Indicate the use of regular expressions and built-in functions to navigate the file system.
O5: Infer the Object-oriented Programming concepts in Python

Course Outcomes:

After Successful 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	Express proficiency in the handling of strings and functions.
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
CO4	Identify the commonly used operations involving file systems and regular expressions.
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

CO-PO Mapping:

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

Module 1: (8L)

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, Functions, 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 2: (7L)

Strings, 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 3: (7L)

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, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset.

Module 4: (7L)

Files, 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

Module 5: (7L)

Object-Oriented Programming, Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism.

TEXT BOOK

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

REFERENCE BOOKS:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
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. ISBN – 13: 978-9352139057.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018. ISBN-13: 978-1491991732.

Course Name: Microprocessor and Microcontrollers Lab
Course Code: ECS491
Contact: 0:0:3
Credits: 1.5

Course Objective(s):

The objective of the course is to make the students able to –
O1: analyze microprocessors and microcontrollers.
O2: grow programming concept using microprocessor.
O3: write programs, interface with peripherals and implement them in projects.
O4: choose suitable microprocessors and microcontrollers for any design and implementations.
O5: interface microprocessors and microcontrollers with peripheral devices.

Course Outcomes:

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

CO1	develop microprocessor based programs to solve any given problem statement.
CO2	develop microcontroller based programs to solve any given problem statement.
CO3	design microprocessor based systems for real time applications.
CO4	design microcontroller based interfacing as per the requirements.

CO-PO Mapping:

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

List of Experiment:

1. Familiarization with 8085 and 8051 trainer kit components.
Program development using basic instruction set (data transfer, Load/ Sore, Arithmetic, Logical) using 8085 and 8051 trainer kit such as

a) Addition and subtraction
b) Copying and shifting a block of memory
c) Packing and unpacking of BCD numbers
d) Addition of BCD numbers
e) Binary to ASCII conversions
f) String matching

g) Multiplication of two numbers
h) Sorting of array of numbers

2. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit, write subroutine for delay, reading switch state & glowing LEDs accordingly, finding out the frequency of a pulse train etc.
3. ADC interfacing with 8051 trainer kit.
4. Innovative experiment

Text book:

1. Microprocessor Architecture, Programming and Applications with 8085/8085A, Ramesh S. Gaonkar, Wiley Eastern Ltd., 1st Edition, 1989.
2. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi & Janice Gillispie Mazidi, Pearson Education Inc., 2nd Edition, 2006.
3. The 8051 Microcontroller: Architecture, Programming and Applications, Kenneth J. Ayala, West Publishing Company, 1st Edition, 1991.

Reference Books:

1. Fundamentals of Microprocessor and Microcontrollers, B. Ram, Dhanpat Rai Publications, Revised Edition, 2011.
2. The 8085/8085A Microprocessor Book, Intel Corporation, Wiley Interscience Publications, 1st Edition, 1980.
3. Microcontrollers: Theory and Applications, Ajay V. Deshmukh, Tata McGraw-Hill, 1st Edition, 2005.

Course Name: Operating Systems Lab
Course Code: ECS492
Contacts: 0:0:3
Credits: 1.5

Prerequisites:

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

Course Objective(s):

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

O1. To introduce essential Linux commands for effective file handling, process monitoring, and basic system operations, enabling students to navigate and manage a Unix/Linux environment proficiently.
O2. To develop students' ability to write and execute shell scripts using variables, control structures, and functions for automating tasks and performing system-level operations.
O3. To provide hands-on experience in managing processes, including creation, duplication, and replacement of process images, fostering an understanding of process control mechanisms.
O4. To enable students to write concurrent programs using inter-process communication (IPC) mechanisms like semaphores and POSIX threads, ensuring effective synchronization and multithreading.

Course Outcome(s):

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

CO1	analyze different aspects of Linux.
CO2	create or design different scripts using shell programming.
CO3	implement process, thread, semaphore concept of operating system.
CO4	create shared memory with the implementation of reading from, write into shared memory.

CO PO Mapping:

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

Course Contents:

1. **Essential Linux Commands[9P]:** 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)
2. **Shell Programming [6P]:** Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).
3. **Process [3P]**: Starting new process, replacing a process image, duplicating a process image.
4. **Semaphore [3P]:** Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).
5. **POSIX Threads[6P]:** Programming with pthread functions(viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel) .
6. **Shared Memory [9P]:**Create the shared memory , Attach the shared memory segment to the address space of 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

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

Course Name: Data Base Management System Lab
Course Code: ECS493
Contact: 0:0:3
Credits: 1.5

Prerequisites:

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

Course Objective(s):

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

O1: learn the data models, conceptualize and depict a database system.
O2: learn the fundamental concepts of SQL queries.
O3: understand the concept of designing database with the necessary attributes.
O4: know the methodology of Accessing, Modifying and Updating data & information from the relational databases.
O5: learn database design as well as to design user interface and how to connect with database.

Course Outcomes (COs):

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

CO1	Understand the basic concepts regarding databases, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.
CO2	Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.
CO3	Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries
CO4	Analyze database system concepts and apply normalization to the database and to create different transaction processing.

CO-PO Mapping:

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

CO4	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**3**

List of Experiment:

1. Structured Query Language (SQL)
2. Creating Database (SQL DDL).
3. Creating a Table Specifying Relational Data Types Specifying Constraints, Creating Indexes, DROP, ALTER, TRUNCATE
4. Table and Record Handling: (SQL DML).
5. INSERT, SELECT, UPDATE etc.
6. Retrieving data from a database
7. Using the WHERE clause
8. Using Logical Operators in the WHERE clause
9. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
10. Using Aggregate Functions
11. Combining Tables Using JOINS : (Inner Join, Theta Join, Equi Join, Left Outer Join, Right Outer Join, Full Join)
12. Write a query to use & identify Primary Key & Foreign Key.
13. Fetching data using Sub-queries in where clause, having clause etc.
14. Creating Column Aliases Creating Database Users Using GRANT and REVOKE
15. Design and implementation of Library Management System.
16. Design and implementation of Hospital Management System.
17. Innovative Experiment

Text Books:

1) SQL, PL/SQL by Ivan Bayross, BPB Publications
2) Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

Course Name: Communication Engineering Lab
Course Code: EC(ECS)491
Contact: 0:0:3
Credits: 1.5

Prerequisites: Basic concept of Signals and Systems, Analog and digital electronic circuits

Course Objective(s):

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

O1: Understand the principles and applications of analog and digital modulation techniques.
O2: Design and implement AM, FM, and digital modulation schemes using hardware or simulation.
O3: Demonstrate and analyze the working of multiplexing and demodulation techniques.
O4: Interpret time and frequency domain characteristics of modulated signals.
O5: Develop and present innovative communication-related experiments with practical relevance.

Course Outcomes (Cos):

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

CO1	demonstrate amplitude and frequency modulation techniques and calculate modulation indices.
CO2	generate and analyze DSB-SC and SSB-SC modulated signals.
CO3	apply PAM, PWM, and FSK techniques and interpret modulated and demodulated signals.
CO4	construct and analyze Time Division Multiplexing (TDM) circuits.
CO5	design and present an innovative communication system experiment using hardware/simulation.

CO-PO Mapping:

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

Course Content:

List of Experiment:

1. Study of modulation index in Amplitude modulation and construction of envelope for different values of modulation index using hardware/ MAT Lab/Simulink/Lab-view.

2. Generation and observation of Single Side Band Suppressed Carrier (SSB-SC) & Double Side Band Suppressed Carrier (DSB-SC) signal using hardware/ MAT Lab/Simulink/Lab-view.

3. Generation and observation of Signal using hardware/ MAT Lab/Simulink/Lab-view.

4. Generation and observation of Frequency Modulation & Demodulation and calculation of modulation index using hardware/ MAT Lab/Simulink/Lab-view.

5. Generation of Time Division Multiplexing (TDM) & Frequency Division Multiplexing (FDM) using hardware/ MAT Lab/Simulink/Lab-view.

6. Generation and observation of Perform Sampling, PAM, PWM, PPM generation and detection using hardware/ MAT Lab/Simulink/Lab-view.

7. Perform PCM modulation and demodulation using hardware/MAT Lab/Simulink/Lab-view.

8. Study of ASK and FSK modulation system and observation the modulated and demodulated Waveforms using hardware/ MAT Lab/Simulink/Lab-view.

9. Perform generation and detection of BPSK and QPSK using MAT Lab/Simulink/Lab-view.

10. Design and Analysis of Superheterodyne Receiver using MAT Lab/Simulink/Lab-view.

11. Study of Error Detection and Correction using Hamming Code using MAT Lab/Simulink/Lab-view.

12. Innovative Experiment on Design of Reconstruction Filter (Analog/Digital) for Demodulator/ hardware based Envelop Detector

Text book:

1. Modern Digital and Analog Communication Systems, B.P. Lathi, Oxford University Press,4th Edition,2017
2. Communication Systems, Simon HaykinWiley India,4th Edition, 2013
3. Analog and Digital Communication, K. Sam Shanmugam, Wiley India,1st Edition,2005
4. Principles of Communication Systems, Taub and Schilling, McGraw Hill Education,3rd Edition,2007
5. Digital and Analog Communication Systems, Leon W. Couch, Pearson,8th Edition,2013

Reference Books:

1. Analog and Digital Communication Systems, P. Chakrabarti, Dhanpat Rai & Co., Revised Edition,2018
2. Communication Systems (Analog and Digital), Dr. Sanjay Sharma, S. K. Kataria & Sons, Latest Edition,2022
3. Digital Communication John G. Proakis , McGraw Hill Education,5th Edition,2008
4. Principles of Digital Communication. P. Chakrabarti, Dhanpat Rai & Co.,1st Edition,2015

Course Name: Soft Skills and Aptitude
Course Code: HU(ECS)491
Contact: 0:0:2
Credit:1

Prerequisites: Basic mathematics, English communication skill

Course Objective(s):

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

O1: To develop professional communication skills and workplace etiquette.

O2: To strengthen verbal reasoning, numerical ability, and logical thinking for aptitude tests.

O3: To cultivate leadership, teamwork, and interpersonal effectiveness

Course Outcomes (COs):

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

CO1	Develop effective communication skills (verbal, written, and non-verbal) for professional environments.
CO2	Enhance problem-solving and analytical thinking through logical reasoning and aptitude training.
CO3	Enhance problem-solving and analytical thinking through logical reasoning and aptitude training.
CO4	Manage time efficiently and handle workplace stress through practical strategies.
CO5	Build a professional profile (resume, LinkedIn, portfolio) to enhance employability.

CO-PO Mapping:

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

Course Content:

Module 1: Communication & Corporate Etiquette

Fundamentals of Corporate Communication (Email, Meetings, Reports)
Business Writing: Resume, Cover Letter, and Statement of Purpose (SOP)
Public Speaking & Presentation Skills (With AI/Tech-based Tools)

Group Discussion & Personal Interview Techniques
Corporate Etiquette: Dress Code, Body Language, Networking
Persuasion & Negotiation Skills in Interviews
Handling Workplace Conflicts and Professional Conduct

Practical Exercises: Mock GD & PI Sessions Elevator Pitch Challenge Drafting Business Emails and Reports Role-playing Interview Scenarios

Module 2: Verbal & Analytical Ability for Competitive Exams
Grammar & Sentence Correction
Vocabulary Building & Contextual Usage
Reading Comprehension Techniques
Logical Reasoning: Syllogisms, Blood Relations, Seating Arrangements
Quantitative Aptitude: Percentage, Ratio-Proportion, Time & Work
Data Interpretation & Graphical Analysis
Puzzles and Critical Thinking Exercises
Decision-Making and Problem-Solving Strategies

Practical Exercises: Weekly Verbal & Quantitative Aptitude Tests Logical Puzzles and Reasoning Games Speed Reading & Summary Writing Mock Corporate Aptitude Tests

Module 3: Teamwork, Leadership & Conflict Resolution
Teamwork vs. Individual Contribution
Leadership Styles & Decision Making
Conflict Management & Negotiation Skills

Practical Exercises: Team-Based Problem-Solving Activities Leadership Role-Play Scenarios Conflict Resolution Case Studies Workplace Adaptability Drills

Syllabus of 3rd year _R25_ ECS

3rd Year 5th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	ECS501	Internet of Things and its applications	3	0	0	3	3
2	ENGG	Major	ECS502	Object Oriented Programming with Java	3	0	0	3	3
3	ENGG	Major	ECS503	Introduction to Data Science	3	0	0	3	3
4	ENGG	Major	ECS504A	Embedded System Design	3	0	0	3	3
			ECS504B	Digital Signal Processing					
			ECS504C	VLSI and Microelectronics					
			ECS504D	Measurement and Sensors Technology					
5	ENGG	Minor	CS(ECS)501A	Computer Graphics	2	0	0	2	2
			CS(ECS)501B	Software Engineering					
			CS(ECS)501C	Web and Internet Technology					
			CS(ECS)501D	Ecommerce & ERP					
B. PRACTICAL									
1	ENGG	Major	ECS591	Internet of Things Lab	0	0	3	3	1.5
2	ENGG	Major	ECS592	Object Oriented Programming with Java Lab	0	0	3	3	1.5
3	ENGG	Major	ECS593A	Embedded System Design Lab	0	0	3	3	1.5
			ECS593B	Digital Signal Processing Lab					
			ECS593C	VLSI and Microelectronics Lab					
			ECS593D	Measurement and Sensors Technology Lab					
5	ENGG	Skill Enhancement Course	IT(ECS)591	IT Workshop Lab (SciLab/Python/R/C++)	0	0	3	3	1.5
6	PRJ	Project	ECS581	Project-I	0	0	0	4	2
C. MANDATORY ACTIVITIES / COURSE									
	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
Total of Theory, Practical								31	22

Course Name: Internet of Things and its Applications

Course Code: ECS501

Contact: 3:0:0

Credits: 3

Total Contact Hours: 36

Prerequisite:

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

Course Objective(s):

O1: The course aims to provide comprehensive knowledge of the Internet of Things (IoT), including architecture, communication protocols, hardware interfaces, and industry applications.

O2: Students will gain hands-on skills in building IoT systems using platforms like Arduino and Raspberry Pi and explore real-world domains such as smart cities, healthcare, and industrial IoT.

Course Outcomes (COs):

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

CO1	**Apply** the foundational concepts of the Internet of Things and various **communication protocols** such as MQTT, AMQP, BLE, LoRaWAN, etc., to explain how IoT systems interact across layers..
CO2	**Analyze** the architecture and communication challenges of **Wireless Sensor Networks**, including MAC protocols, sensor deployment strategies, and data dissemination mechanisms.
CO3	**Evaluate** the effectiveness of different **IoT reference architectures**, M2M value chains, and the role of SDN in IoT by comparing architectural views, design principles, and global standards.
CO4	**Create** a basic IoT solution by **programming with Arduino/Raspberry Pi**, integrating sensors, and using platforms such as **ThingSpeak or AWS IoT** to solve real-world problems in domains like **smart cities, healthcare, or agriculture**.

Mapping of COs with POs and PSOs:

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

Course Content:

Module 1: Fundamentals of IoT and Communication protocols (8L)

The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, IoT Architectural Drivers: Scale, Latency, Security, Legacy Devices, Constrained devices and N/Ws, Heterogeneity, Privacy etc. Convergence of IT and OT technologies. Sensing and actuation basics, IoT Protocols at different Layers: MQTT, AMQP, 6LowPAN, WiFi, NFC, BLE, LTE, LoRaWAN etc

Module 2: Wireless Sensor Network (5L)

Wireless Sensor Network, Network & Communication aspects, ISM Band, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination,

Module 3: IoT Architecture (8L)

IoT Architecture, Introduction, Architecture Reference 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. IoT Reference Architecture and M2M value chains, Software-Defined Networking (SDN) and its role in IoT, SDN-IoT integration

Module 4: IoT and M2M (5L)

A Basic Perspective– Introduction, 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.

Module 5: IoT Hardware and Programming and Data Handling, Analytics, and Cloud Platforms (5L)

Introduction to Arduino: programming and sensor interfacing, Introduction to Python, Integration of sensors and actuators, Raspberry Pi, GPIO access, Implementation of IoT with Pi,

Data processing and analytics in IoT, Introduction to Cloud Computing & Sensor-Clouds, Fog Computing and their comparison, Edge Computing, Cloud Platforms: Platforms: ThingSpeak, AWS IoT, Google Cloud IoT

Module 6: IoT Applications and Case Studies [5L]

IoT applications in Smart Cities, Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare, Activity Monitoring, Security, Privacy and Governance in IoT, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform

Text books:

1. **Rethinking the Internet of Things: A Scalable Approach to Connecting Everything**, Francis daCosta, Apress, 1st Edition, 2013
2. **Internet of Things (A Hands-On Approach)**, Vijay Madisetti and Arshdeep Bahga, VPT, 1st Edition, 2014
3. **Introduction to IoT**, Sudip Misra, Anandarup Mukherjee, and Arijit Roy, Cambridge University Press, 1st Edition, 2021

Reference books:

1. **Getting Started with the Internet of Things**, Cuno Pfister, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. **Fundamentals of Wireless Sensor Networks***:* **Theory and Practice**, Waltenegus Dargie and Christian Poellabauer, Wiley, 1st Edition, 2010
3. **Introduction to Industrial Internet of Things and Industry 4.0,** Sudip Misra, Chandan Roy, and Anandarup Mukherjee, CRC Press, 1st Edition, 2020

Course Name: Object Oriented Programming using JAVA
Course Code: ECS502
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic knowledge of computer programming

Course Objective(s):

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

O1: understand the advantages and disadvantages of Java vis a vis C++ and Python

O2: appreciate the strength of the fundamental characteristics of OOP-encapsulation, polymorphism, and inheritance; and different features of Java which are used to implement the fundamental characteristics of OOP

O3: write basic programs in Java by using the keywords and techniques for decision making, looping, creating and manipulating arrays and strings

O4: use the techniques for exception handling, multithreading, and i/o managing in Java.

O5: write programs in Java by using unique features like interface, generics, and Java packages

Course Outcomes (COs):

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

CO1	Write programs in Java by using interactions between classes, objects, and methods, and by using the Java keywords and the operators
CO2	Write programs in Java to implement the special features-interface, generics, exception handling, and multithreading
CO3	Write programs in Java by accessing different packages of Java, particularly java.util.* and java.io.*,and create customized packages
CO4	Write programs in Java to create GUI

CO-PO Mapping:

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

Course Content:

Module 1: Introduction (4L)

Computer programming techniques-low level language and high level language; object oriented programming; Differences between OOP (Java) and other structured programming language (C)advantages and disadvantages of OOP; Properties of OOP-inheritance, encapsulation, polymorphism; Objects and classes and methods, class members, examples in Java; Relationship between class and objects-generalization, specialization, aggregation, , association, composition; links, meta-class, JRE and JDK

Module 2: Basics of Java (10L)

Advantages and disadvantages of Java; Java compiler and interpreter; JVM and byte code; Java and the internet; Different types of variables-instance variable, local variable; parameters and arguments of methods; Data types-Boolean, byte, short, int, long, double, float, double float, char; their ranges, range overflow; Operators-arithmetic, logical, assignment, unary, ternary; Control statements-if, if-else, if-else if ladder, the ? operator, nested if-else; flowcharts and examples for the control statements; Loops- while and do-while loops, their flowcharts; for-loop; variations and special features of for loops in Java; Creation of class, Objects and methods, nested and inner class; Constructor-definition, types and usages; Garbage collection and finalize method; Objects as parameters and methods returning objects, call by value and call by reference; Method and constructor overloading; Abstract and final methods, this keyword; Access specifier-public, default/friendly, protected, private; static variables and methods.

I/O in Java-java.io package, bytestream and characterstream, InputStream and OutputStream classes, Reader and Writer classes; BufferedReader; Scanner class; System.in and System.out; command line arguments

Module 3: Arrays and Strings in Java (4L)

Arrays in Java-one dimensional, two dimensional, and multidimensional arrays; irregular array, enhanced for loop

Strings in Java, mutable and immutable strings; differences between Stringbuffer and Stringbuilder classes; Methods of String class- charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring()**;** Methods of StringBuffer class- append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(); StringBuilder class- append(), delete(),replace().

Module 4: Inheritance and Java Packages (6L)

Inheritance – definition and advantages; different types of inheritance and their implementation, extends keyword; Method overriding/dynamic method dispatch, super and final keywords, super() method

Interface - Definition, use of interface in Java; Multiple inheritance by using interface

Java Packages -definition, the packages and their uses; creation of a package; importing packages, member access for packages

Module 5: Exception handling, Multithreading, Graphics programming using Swing, and Generics (12L)

Exception handling – difference between error and exception, different types of exception classes, difference between checked and unchecked exceptions**;** try & catch, throw, throws and finally**;** user defined exceptions

Multithreading - Basics, main thread, thread life cycle; creation of multiple threads;yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive(); Thread priorities, thread synchronization, interthread communication, deadlocks for threads

Graphics programming-applets,applet life cycle, difference between application & applet programming**;** Parameter passing in applets; graphics class, lines and rectangles, shapes-circle, ellipse,and polygon; awt-class hierarchy in awt package; an awt frame and an awt button; Swing-class hierarchy in swing package; JApplet, JFrame, JButton, Jtree, JComboBox, JTabbedPane; awt vis swing

Generics-generic type, generic class, wildcard arguments,generic methods, generic constructors, generic interfaces

Text books:

1. Java: A Beginner's Guide , Herbert Schildt, McGraw-Hill, 7th Ed.(or later)
2. Programming With Java , E. Balaguruswamy, McGraw-Hill, 6th Ed.(or later)
3. Let us Java, Yashavant Kanetkar and Anuj Kanetkar, BPB, 7th Ed.(or later)

Reference Books:

1. Java: The Complete Reference, Herbert Schildt, McGraw-Hill, 9th Ed.(or later)
2. Art and Science of Java, Eric Roberts, Pearson, 1st Edition (or later)
3. Introduction to Programming Using Java, David J.Eck url: http://math.hws.edu/javanotes

Course name: Introduction to Data Science

Course code: ECS503

Contacts: 3:0:0

Credits: 3

Total contact hours: 36

Course Objective(s):

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

O1: make the learner understand the data analysis, regression, and regularization
O2: make the learner acquainted with data classification, classification, and feature engineering
O3: make the learner able to apply text mining
O4: make the learner understand network analysis

Course Outcomes (COs):

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

CO1	Select and evaluate a model.
CO2	Classify data.
CO3	Use the technique of clustering.
CO4	Use text mining and retrieve information

CO-PO Mapping:

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	2	2	1	1	1	1	3	1	2
CO2	3	2	3	2	3	2	1	1	2	1	2	3	2	2
CO3	3	3	3	3	3	1	1	1	2	2	2	3	1	2
CO4	3	3	3	2	3	2	1	2	2	2	2	2	2	3

Course Content:

Module I: (10L)

Introduction to data science, Exploratory data analysis, Linear regression and regularization, Model selection and evaluation

Module II: (10L)

Classification: KNN, decision trees, SVM; Ensemble methods: random forests, Naïve Bayes and logistic regression

Module III: (8L)
Feature engineering and selection, clustering: k-means, hierarchical clustering, Dimensionality reduction:
PCA and SVD

Module IV: (8L)

Text mining and information retrieval, Network Analysis, Recommender systems

Text Books:

1. Data Science, Herbert Jones, Bravex Publications, Illustrated Edition, 2020.
2. Data Science from Scratch, Joel Grus, O'Reilly Media, 1st Edition, 2015.

Reference Books:

1. Data Science Fundamentals and Practical Approaches, G. Anand and R. Sharma, BPB Publication, 1st Edition, 2020.
2. Data Science for Business, F. Provost and T. Fawcett, Shroff Publishers, 1st Edition, 2013.
3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, and Peter Gedeck, O'Reilly Media, 2nd Edition, 2020.

Course Name: Embedded System Design
Course Code: ECS504A
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Microprocessor and Microcontroller

Course Objective(s):

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

O1: An ability to design a system, component, or process to meet desired needs within realistic constraints.

O2: Ability to understand microcontroller, microcomputer, embedded system.

O3: Understand different components of a micro-controller and their interactions.

O4: To become familiar with the programming environment used to develop embedded systems.

O5: Understand key concepts of embedded systems like IO, timer, interrupts, interaction with peripheral devices

O6. Learn debugging techniques for an embedded system

Course Outcomes (COs):

CO1	Understand the architecture and classifications of different embedded systems and the related programming knowledge.
CO2	Understand the concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices
CO3	Choose case-specific debugging technique for an embedded system.
CO4	Design various real time systems using embedded systems

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	-	2	1	2	-	-	-	2	-	3	3	2	3
CO2	2	1	3	2	1	-	-	-	1	-	2	3	3	3
CO3	2	2	3	1	1	-	-	-	1	-	1	2	1	1
CO4	3	2	2	-	-	-	-	-	-	-	1	1	2	3

Course Content:

Module 1: Introduction to Embedded Systems and Processors (5L)

Introduction to the Embedded System: Embedded system Vs General computing systems, Purpose of Embedded systems, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, ASIC.

Module 2: Communication Protocols in Embedded Systems (9L)

Serial and parallel communication: devices and protocols, wireless communication: devices and protocols, parallel communication network using ISA,PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth.

Module 3: Program Modeling and Hardware-Software Co-Design (5L)

Program Modeling Concepts; Fundamental issues in Hardware software co-design,Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system

Module 4: Real-Time Operating Systems (RTOS) Fundamentals (5L)

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS

Module 5: PIC Microcontroller Architecture and Applications (12L)

PIC microcontroller: introduction, architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, assembly language programming, addressing modes, instruction set, interfacing with various sensors and actuators using PIC microcontroller. Programming concepts and embedded programming, embedded architecture

Text book:

1. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill Education, 3rd Edition, 2017
2. Embedded System Design, Frank Vahid and Tony Givargis, Wiley, 1st Edition, 2002
3. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearson, 2nd Edition, 2006
4. PIC Microcontrollers: An Introduction to Microelectronics, Martin Bates, Newnes (Elsevier), 3rd Edition, 2011

Reference Books:

1. Embedded Systems: A Contemporary Design Tool, James K. Peckol, Wiley, 2nd Edition, 2019
2. Real-Time Concepts for Embedded Systems, Qing Li and Caroline Yao, CMP Books, 1st Edition, 2003
3. Programming Embedded Systems in C and C++, Michael Barr and Anthony Massa, O'Reilly Media, 2nd Edition, 2006

Course Name: Digital Signal Processing
Course Code: ECS504B
Contact: 3:0:0
Contact Hours: 36
Credit: 3

Prerequisites: Analog Electronics circuit, Signals & Systems, Analog Filters.

Course Objective(s):

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

O1: To develop the knowledge on signals used in digital signal processing.

O2: To impart the knowledge of the principles of discrete-time signal analysis to perform various signal operations

O3: Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems

O4: To study various sampling techniques and different types of filters

O5: To learn the use of computer programming tools to create, analyze process and visualize signals and to plot and interpret magnitude and phase of LTI system frequency responses

O6: To understand the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.

Course Outcomes (COs):

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

CO1	Apply the knowledge about continuous and discrete time signals.
CO2	Understand the Fourier Transform, and examine the process of Quantization and the effects offinite register length.
CO3	Understand and implement DFTs on long data sets such as speech signals and images.
CO4	Develop different types of FIR & IIR filter structures and theirimplementations.
CO5	Use of FFTs for efficient implementation of linear convolution
CO6	Excel in fields such as speech processing, audio signal processing, digital image processing, video and audio compression.

CO-PO Mapping:

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

Course Content:
Module 1: LTI systems: (8L)

Concept of signals & systems, digital signal processing and its relevance to digital communication. Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.

Module 2: Discrete Fourier Transform: (16L)

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain. Concept and relations for DFT/IDFT; Relation between DTFT & DFT; Twiddle factors and their properties; DFT/DFT as linear transformation and matrices ; Computation of DFT/IDFT by matrix method; Properties of DFT – periodicity, linearity, time reversal, circular time & frequency shift, symmetry, circular symmetry, duality, multiplication of two DFTs, circulation convolution, circular correlation ; Computation of circular convolution by graphical; Linear filtering using DFT, aliasing error, filtering of long data sequences- Overlap- Save and Overlap- Add methods. Fast Fourier Transforms: Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises.

Module 3: Filter Design: (6L)

Basic concepts of IIR and FIR filters, difference equations, design of using impulse invariant and bilinear transform. Concept of Chebyshev filters and comparison with Butterworth filter. Design of linear phase FIR filters -no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization. Some examples on practical filters. Multirate Digital Signal Processing: Introduction to multirate digital signal processing, sampling rate conversion, multistage interpolator & decimator, digital filter banks.

Module 4: Digital Signal Processor: (6L)

Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713processor, writing of small programs.

Text Books:

1. Digital Signal Processing: Principles, Algorithms and Applications, J.G. Proakis & D.G. Manolakis, Pearson Education, 4th Edition, 2007
2. Digital Signal Processing: A Computer Based Approach, S.K. Mitra, TMH Publishing Co., 4th Edition, 2011
3. Digital Signal Processing: Signals, Systems and Filters, A. Antoniou, TMH Publishing Co., 1st Edition, 2006
4. Digital Signal Processing, A.V. Oppenheim, R.W. Schafer, Prentice Hall, 1st Edition, 1975

Reference Books:

1. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India), 1st Edition, 2004
2. Digital Signal Processing, S. Salivahanan, A. Vallavaraj & C. Gnanapriya, TMH Publishing Co., 2nd Edition, 2010
3. Digital Signal Processing: A Hands-on Approach, C. Schuler & M. Chugani, TMH Publishing Co., 1st Edition, 2009

Course Name: VLSI & Microelectronics
Course Code: ECS504C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic concept of Electronic Devices, Analog & Digital Electronic Circuits

Course Objective(s):

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

O1: Understand VLSI design flow: Learn the steps involved in designing and fabricating VLSI circuits, from specification to layout.

O2: Design and analyze digital circuits: Understand how to design and analyze digital circuits using VLSI design tools and methodologies.

O3: Apply VLSI design principles: Apply principles of VLSI design to create complex digital systems, such as microprocessors and memory devices

O4: Use VLSI design tools: Familiarize yourself with VLSI design tools, such as simulation software, layout editors, and synthesis tools.

Course Outcomes (COs):

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

CO1	Able to illustrate scale of integration – SSI, MSI, LSI, VLSI, Moor's Law, scaling, short channel effect, VLSI design flow, FPGA architecture, classify Standard IC & ASIC, and construct gate level circuit with the help of PAL & PL architecture.
CO2	Able to analyze CMOS inverter voltage transfer characteristics with the parameters – VIL , VIH , VOL ,VOH , Vth and based on the knowledge of digital circuit design methodology like–CMOS, Pass transistor, TG , DCVSL , dynamic logic , NORA , able to construct schematic of simple and complex combinational circuit, sequential circuit(SRflip-flop ,JK flip-flop ,D flipflop), 6T- SRAMCell,3T-DRAMcell using MOSFET.
CO3	Able to estimate the value of resistance of current source/sink, MOS diode , current of current mirror circuit , voltage of reference circuits (voltage divider , threshold voltage references and band gap reference), value of parameters to design CMOS differential amplifier , resistance of switch capacitor circuit , gain of switch capacitor integrator and 1st order switch capacitor filter based on the concept of small signal model & switching characteristics of MOSFET.
CO4	Able to describe the fabrication steps of ICs and construct the diagram & layout of CMOS inverter & basic gates based on lambda and micron design rules.
CO5	Able to describe the fabrication steps of ICs and construct the diagram & layout of CMOS inverter & basic gates based on lambda and micron design rules.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to IC (5L)

Integrated Circuits – Advantages, disadvantages, limitations; Scale of Integration – SSI, MSI, LSI, VLSI, ULSI; Moor's Law; Scaling of MOSFET-Constant field scaling and constant voltage scaling, Short Channel Effects; VLSI design flow, Y- Chart, IC Classification –Standard IC and ASIC, PAL, PLA, FPGA Architecture.

Module 2: Digital VLSI Circuit Design (11L)

Inverter Characteristics

Resistive load inverter – Voltage transfer characteristics (VTC, significance of parameters (only expression, no derivation) –VIL, VIH, VOL, VOH, Vth; CMOS inverter-VTC, Noise margin and aspect ratio of symmetric CMOS inverter.

Combinational Logic Circuit Design

Circuit design using Static CMOS style–basic gates, design of circuit for product of sum(POS) and sum of product (SOP) expression, Complex logic circuit, full adder; Circuit design using pseudo NMOS logic, DCVSL Logic, TG Logic, Pass Transistor Logic, Complementary pass transistor logic, Dynamic logic, domino logic, NORA logic.

Sequential Circuit and Semiconductor Memory Design

Bistable Circuit-Design of CMOSS-R&J-K Latch, CMOS Clocked SR & JK Latch/Master–slave JK Flip-flop, CMOS D Flipflop; 6T SRAM cell and 3T DRAM cell design.

Module 3: Analog VLSI Circuit Design (9L)

Small Signal model of MOSFET; Analog sub-circuits -MOS Switch, Active resistors/MOS Diode , Current source and Sink, Current Mirror ;Current and voltage references-voltage divider

, MOS equivalent of P-N junction Voltage reference , Threshold voltage reference , Band gap reference (Basic Principle) ; Switch- Capacitor Circuit – resistance emulation of series , parallel and series-parallel circuit , Switch capacitor integrator and filter (1st order only) ;CMOS differential amplifier–design parameters; Output amplifier (basic circuit); Block diagram of two-stage CMOS OP-AMP (description only).

Module 4: Layout Design Rules and Fabrication Steps of ICs (6L)

Micron and lambda design rules; Stick diagram and Layout - CMOS Inverter, NAND and NOR gate; Fabrications steps of IC – Wafer preparation, Oxidation, photolithography, etching, diffusion, ion-implantation, metallization, and packaging. CMOS N-Well Process, overview of P-well and twin-tub process.

Module 5: Introduction to Low Power and High-Speed VLSI Circuit Design (5L)

Dynamic power, short circuit power and leakage power in CMOS Inverter; Switching activity &Logical effort of basic gates; Timing parameters (concept only) –Critical path, arrival time, slack, skew, set-up time, hold time, gate delay and path delay, delay time expression of CMOS inverter (expression only), Adiabatic logic (basic concept).

Text Books:

1. Digital Integrated Circuits, J. M. Rabaey, A. Chandrakasan, B. Nikolic, Pearson Education, 2nd Edition, 2003
2. CMOS Digital Integrated Circuits: Analysis and Design, S. M. Kang & Y. Leblebici, TMH, 3rd Edition, 2003
3. CMOS Analog Circuit Design, P. E. Allen & D. R. Holberg, Oxford University Press, 2nd Edition, 2002
4. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H.E. Weste & David Harris, Pearson Education, 4th Edition, 2010

Reference Books:

1. Microelectronic Circuits, Adel S. Sedra & Kenneth C. Smith, Oxford University Press, 7th Edition, 2015
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley, 1st Edition, 2002
3. VLSI Design, Debaprasad Das, Oxford University Press, 2nd Edition, 2021
4. VLSI Design and EDA Tools, Angsuman Sarkar, Swapnadip De, C.K. Sarkar, Scitech Publications, 1st Edition, 2010

Course Name: Measurement and Sensors Technology
Course Code: ECS504D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic Electrical and Electronics Engineering

Course Objective(s):

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

O1: To introduce the fundamentals and importance of measurement systems and electrical instruments.
O2: To apply bridge methods for measuring resistance, capacitance, and inductance.
O3: To understand sensors and transducers for measuring physical quantities.
O4: To explore advanced sensing technologies for modern applications.

Course Outcomes (COs):

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

CO1	Identify and describe principles and characteristics of electrical measuring instruments.
CO2	Apply bridge circuits to measure resistance, capacitance, and inductance.
CO3	Analyze and evaluate sensors and transducers for measuring physical quantities.
CO4	Understand smart sensor technologies and their modern applications.

CO-PO Mapping:

CO	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
CO 1	3	2	-	2	2	-	-	-	-	-	2	3	2	1
CO 2	3	2	2	2	3	-	-	-	-	-	2	3	2	2
CO 3	2	3	2	3	3	-	-	-	-	-	3	2	3	2
CO 4	2	2	2	2	3	2	1	-	1	1	3	2	2	2

Course Content:

Module I: Fundamentals of Measurement and Electrical Instruments (7L)
Introduction, Definition, the significance of measurement and instruments, General concepts and terminology of measurement systems, Static & dynamic characteristics of instruments.
Introduction to electrical voltmeters and ammeters: PMMC, MI, Electrodynamometer:

Construction, Torque equation, Damping, range extension.

Module II: Measurement of Resistance, Capacitance, and Inductance (9L)
Measurement of Resistance: Wheatstone bridge & Kelvin's Double bridge (DC Bridge), Meggar.
Measurement of Capacitance: De Sauty's bridge & Schering bridge (AC Bridge) **Measurement of Inductance:** Maxwell's inductance capacitance bridge (AC Bridge), Anderson Bridge.

Module III: Principles and Applications of Sensors and Transducers (10L)
Introduction to sensors and transducers, Principles of sensing & transduction, Classification of sensors, sensitivity calculation, error estimation.
Resistive Sensing Element: Potentiometer, Strain gauge: Basics, types, temperature compensation, and applications: force, velocity and torque measurements.
Inductive Sensing Element: Self-inductive transducer, Mutual inductive transducers, Linear Variable Differential Transformer (LVDT): construction, Characteristic Curve.
Capacitive Sensing Element: Basic concepts of Variable Area Type, Variable distance type, Variable Permittivity type, calculation of sensitivities, applications.

Module IV: Advanced Sensing Elements and Modern Sensor Technologies (10L)
Piezoelectric & Piezo resistive Sensing Element: Piezoelectric effects, charge and voltage coefficients, crystal model, materials, force and stress sensing, piezoelectric accelerometer, piezo resistive sensor.
Tachometers: Stroboscopes, seismic accelerometer, Measurement of vibration.
Optical Sensors: Light Dependent Resistor, Photodiode, Phototransistor etc.
Magnetic Sensors: Sensors based on Villari effect for assessment of force, torque, rpm meters, Hall Effect based sensors.
Miscellaneous Sensors & Their Applications:
IC temperature Sensor, Thick film-based sensor, MEMS based sensors, Nano sensors, Sensors for intelligent systems, Introduction to Smart sensors and Sensor network.

Text book:

1. Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co., 19th Edition, 2013.
2. Sensors and Transducers, D. Patranabis, Prentice Hall of India, 2nd Edition, 2003.
3. Transducers and Instrumentation, D.V.S. Murty, PHI Learning Pvt. Ltd., 2nd Edition, 2010.
4. Principles of Measurement Systems, John P. Bentley, Pearson Education, 4th Edition, 2005.

Reference Books:

1. Electronic Instrumentation, H.S. Kalsi, Tata McGraw Hill Education, 3rd Edition, 2010.
2. Measurement Systems: Application and Design, Ernest O. Doebelin and Dhanesh N. Manik, McGraw Hill Education, 5th Edition, 2011.
3. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfrick and William D. Cooper, Prentice Hall of India, 1st Edition, 1990

Course Name: Computer Graphics
Course Code: CS(ECS)501A
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:
Fundamental mathematics, Coordinate geometry, Principle of Computer Programming

Course Objective(s):

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

O1: introduce the use of the components of a graphics system and become familiar with building approachof graphics system components and algorithms related with them.

Course Outcomes (COs):

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

CO1	Understand the basic computer graphics and Identify different media representations of differentmultimedia data and data formats, windows, clipping and view-ports object representation
CO2	Comprehend the concept of geometric, mathematical and algorithmic concepts necessary for programming computer graphics
CO3	Differentiate windows, clipping and view-ports object representation in relation to images displayedon screen.
CO4	Distinguish different coding technique and software tools for solving real world problems related tographics and multimedia.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to Computer Graphics and Display Technologies (6L)
Introduction to computer graphics, Importance and applications of computer graphics, Basic

Terminologies in Graphics, lookup table, 3D viewing devices, I/O devices, Active & Passive graphics, Computer graphicssoftware. Display: Light & Color models, Raster Scan and Random scan displays, CRT basics, video basics, Flat panel displays

Module 2: Scan Conversion and Drawing Algorithms (6L)
Scan conversion: Points & lines, Line drawing algorithms: DDA algorithm, Bresenham's line algorithm, Circle drawing algorithm: Bresenham's circle drawing algorithm, Mid-point circle drawing algorithm, Scan line polygon fill algorithm, boundary fill algorithm, flood fill algorithm

Module 3: 2D and 3D Transformations (8L)
2D and 3D Transformation Basic transformations: translation, rotation, scaling, Matrix representations & homogeneous coordinates, transformations between coordinate systems, Composite transformation, Pivot point transformation, reflection shear, 3D transformations: translation, rotation, scaling.

Module 4: 2D Viewing and Clipping Algorithms (8L)
2D-Viewing & Clipping: Viewing pipeline, Window to viewport co-ordinate transformation. World co-ordinate, Device co-ordinate, Normalized co-ordinate, Point clipping, line clipping (Cohen Sutherland line clipping algorithm, Mid-point sub division line clipping algorithm), Polygon Clipping (Sutherland Hodgman Polygon Clipping algorithm, Weiler Atherton Polygon clipping algorithm)

Module 5: Projections and Curves (4L)
Projection: Basic concepts, Parallel Projection, Perspective Projection Curves: Bezier curves, B-spline curves.

Module 6: Hidden Surface Removal Techniques (4L)
Hidden Surface Removal: Basic concepts, Z-buffer algorithm, Back face detection, BSP tree method, Painter'sAlgorithm

Text Books:
1. Computer Graphics C Version, Donald Hearn, M. Pauline Baker, Pearson Education, 2nd Edition, 2011
2. Computer Graphics, Samit Bhattacharya, Oxford University Press, 1st Edition, 2018
3. Principles of Interactive Computer Graphics, William M. Newman, Robert F. Sproull, McGraw Hill Education, 2nd Edition, 2001
4. Computer Graphics: Principles and Practice, John F. Hughes, Andries van Dam, Morgan McGraw Hill, 3rd Edition, 2013

Reference Books:
1. Schaum's Outlines Computer Graphics, Ray A. Plastock, Gordon Kalley, McGraw-Hill Inc., 2nd Edition, 2000
2. Mathematical Elements for Computer Graphics, David Rogers, J. Alan Adams, McGraw Hill Education, 2nd Edition, 1990
3. Procedural Elements for Computer Graphics, David F. Rogers, McGraw Hill Education, 2nd Edition, 2001

Course Name: Software Engineering

Course Code: CS(ECS)501B
Contact:3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:
Mathematics, Data Structure and Basic Computations

Course Objective(s):

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

O1. gain a broad understanding of the discipline of software engineering and its application to the development of and management of software systems. Knowledge of basic software engineering methods and practices and their appropriate application.

Course Outcomes (COs):

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

CO1	Ability to analysis and design of complex systems and meet ethical standards, legal Responsibilities.
CO2	Ability to apply software engineering principles, techniques and develop, maintain, Evaluate large-scale software systems.
CO3	To produce efficient, reliable, robust and cost-effective software solutions and perform independent research and analysis.
CO4	Ability to work as an effective member or leader of software engineering teams andmanage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to Software Engineering and SDLC Models (6L)

Introduction: Definition of Software Engineering, Software crisis, Evolution of technology- Hype curve, Exploratory style of Software development vs. Software Engineering, Human cognition mechanism, Software Engineering principle- abstraction and decomposition

Software Development Life Cycle (SDLC) models: Water fall model, V-shape Model, Prototyping Model, Spiral Model, RAD Agile Model, Verification and Validation.

Module 2: Software Project Management and Requirement Analysis (10L)

Software Project Management: Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling- CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning. Requirement analysis and specification: SRS, Requirement gathering and specification, Functional requirement, Traceability.

Module 3: Software Design, Coding, and Testing (15L)

Software Design: Characteristics of a good software, Cohesion and coupling, Function oriented design- DFD, Structure chart. Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow-oriented Design, Program Design and the requirements. Object oriented design- class and relationship, UML diagrams. Coding and Testing: Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclometric Complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing.

Module 4: Software Reliability, Quality Management, and CASE Tools (5L)

Software Reliability and Quality Management: Reliability, Hazard, MTTF, Repair and Availability, Software quality, Software reliability and fault-tolerance, six-sigma.

Computer-aided software engineering: Computer-aided software engineering (CASE)- environment and benefit. Function point methods (FSM, ISO, OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001

Text Books:

1. Software Engineering, Rajib Mall, PHI Learning, 5th Edition, 2018
2. Software Engineering – A Practitioner's Approach, Roger S. Pressman, McGraw-Hill International Edition, 7th Edition, 2010
3. Fundamentals of Software Engineering, Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Pearson Education, 2nd Edition, 2002
4. An Integrated Approach to Software Engineering, Pankaj Jalote, Narosa Publishing House, 3rd Edition, 2005

Reference Books:

1. Software Engineering, Ian Sommerville, Pearson Education Asia, 9th Edition, 2011
2. Software Engineering: A Precise Approach, Pankaj Jalote, Wiley India, 1st Edition, 2010
3. Object-Oriented and Classical Software Engineering, Stephen R. Schach, McGraw-Hill Education, 8th Edition, 2010

Course Name: Web and Internet Technology
Course Code: CS(ECS)501C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Computer Networking, Database Management System, JAVA Programming Language. Course Objective: Describing the web application architecture and protocols, illustrating different technologies those are used to develop web applications, describing different frameworks those used to develop web applications.

Course Objective(s):

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

O1: Learn the principles of web design, including structuring websites, using HTML, CSS for styling, and creating interactive elements with JavaScript.

O2: Develop skills in using JavaScript for creating dynamic and interactive web pages.

O3: Gain knowledge and experience in server-side technologies like PHP, JSP, or servlets for building more complex web applications.

O4: Learn how to connect websites to databases for storing and retrieving data.

Course Outcomes (COs):

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

CO1	Understand web application architecture, technologies, and frameworks.
CO2	Apply the concept of different front end and back-end components in problem solving.
CO3	Analyze different architecture and web components.
CO4	Evaluate different solutions in field of web application development.
CO5	Design web application architecture to provide solution in web application development fields.

CO-PO Mapping:

CO	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
CO 1	1	2	1	3	1	2	3	3	2	1	1	2	1	1
CO 2	3	1	2	3	3	2	1	1	2	1	1	3	2	2
CO 3	2	1	1	1	2	1	3	1	2	3	3	2	2	1

CO 4	**2**	**1**	**2**	**1**	**3**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**2**
CO 5	**1**	**1**	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**2**

Course Content:

Module 1: Introduction to World Wide Web and Internet Standards (2L)
Introduction to World Wide Web: Web Architecture, Web Applications, Web servers, Web Browsers and Agents, Internet standards, DNS, SMTP, Pull and Push mechanism: Pros and Cons. HTTP, HTTPS, XMPP.

Module 2: Markup Languages: HTML and CSS (4L)
Mark-up: HTML: Elements, Attributes, Tags, Forms, Input, Frames, Tables. Cascading Style Sheets: Advantages, Rules, CSS, inline and external, using template Layouts.

Module 3: JavaScript and Node.js Programming (5L)
Java Script and Node JS: Basic java Script concepts, Use of Java Script, Variable, Object, function, Event Handling. Evaluation of Java Scrip. Create, Publish, Extend & Manage, Node.js HTTPs: Create Server and Get Data, Node.js Express, Node JS Mongo DB. Node.js Promise, Node.js Generators & Compare with Callbacks, Node js Streams: File stream, Pipes, Node.js Testing with Jasmine.

M**odule 4: Server-side Programming with Servlets (7L)**
Server-side Programming: Servlets: HTTP Tunneling, Programmatically issuing HTTP GET, POST etc. and retrieval of content Concept of Dynamic Web pages, Web server versus Application server, Role of threading in a Server, Servlet-2.x API conforming to Web 2.0: Role of web.xml as deployment descriptor, request and response, Basic request handling, parameter retrieval, multiple parameter retrieval, inter-Servlet collaboration: Dispatching the request, Concept of state of web: Sessions , tracking session, Using Cookies and session Id, Parameter passing to and from session, Servlet Filters and common uses of Filters and Cookies. Migration to Servlet 3.x plus and omission of web.xml and concept of Web Socket.

Module 5: Database Connectivity and Persistence with JDBC (6L)

Persistence: JDBC 3.x framework: Need and different approaches of persistence of data, Connecting to databases using c, ODBC bridge and Type-4 drivers, Executing basic CRUD using JDBC: Statement, Prepared Statement, Result Set. Execution of batch SQL, Stored Procedures using Callable Statement, Transaction Failure management: Save Point and roll back concepts, Prevention of SQL injection, Concept of connection URL in details: Connecting to a remote database host (server). Concept of roles of Drivers: Java reflection in Action.

Module 6: Java Server Pages and XML Technologies (8L)
Java Server Pages: Benefits of JSP over Servlets, JSP scriptlets, page directives, declarations, action tags: , introduction to MVC and Spring MVC. XML Technologies: XML, Namespace, DTD, W3C XML Schema.

Module 7: AJAX and Asynchronous Web Communication (2L)

Ajax: Introduction to Asynchronous pattern and Using XML to communicate over XML Http Request object. Handling 5 states and finding response state. Migration of Ajax to AJAJ.

Module 8: Web Services and RESTful Architecture (2L)

Web Service Introduction to web service architecture. Simple object access protocol, Web service description language, RESTful web service.

Text Books:

1. Professional Java Server Programming, Subrahmanyam Allamaraju, Apress, 1st Edition, 2007
2. Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black Book, Kogent Learning Solutions Inc., Dreamtech Press, 1st Edition, 2009
3. Core Servlets and JavaServer Pages: Volume 1: Core Technologies, Marty Hall, Larry Brown, Pearson Education, 2nd Edition, 2003
4. Web Technology: A Developer's Perspective, N.P. Gopalan, J. Akilandeswari, PHI Learning, 1st Edition, 2013

Reference Books:

1. Web Technologies: A Computer Science Perspective, Jeffrey C. Jackson, Pearson Education, 1st Edition, 2007
2. Beginning Node.js, Basarat Ali Syed, Apress, 1st Edition, 2014
3. JavaScript: The Definitive Guide, David Flanagan, O'Reilly Media, 7th Edition, 2020

Course Name: E-COMMERCE AND ERP
Course Code: IT(ECS)501D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites:
Concepts of Computer Networking, Operating System, Database Management System

Course Objective(s):

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

O1: Explain the characteristics and functions of electronic commerce, including mobile commerce.

O2: Describe the fundamental characteristics of electronic markets.

O3: Identify and compare common business models used in B2C and B2B electronic commerce.

O4: Provide an overview of Enterprise Resource Planning (ERP) systems and related technologies.

O5: Develop skills related to the ERP manufacturing perspective and various ERP modules.

O6: Examine different ERP tools and understand the benefits of implementing ERP systems.

Course Outcomes (COs):

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

CO1	Understand the policy issues related to privacy, intellectual property rights, and establishing identity those are germane to electronic commerce along with the Internet and related technologies.
CO2	Comprehend the underlying economic mechanisms and driving forces of E-Commerce.
CO3	Analyse the impact that electronic commerce is facing and outlines the different digital transaction process and basic concepts of e-commerce.
CO4	Identify different technologies and IT support used in ERP.
CO5	Apply different tools used in ERP.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**2**	**-**	**-**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**1**	**1**	**1**
CO2	**-**	**3**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**1**
CO3	**1**	**2**	**3**	**-**	**-**	**-**	**-**		**-**	**-**	**-**	**2**	**1**	**2**
CO4	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**2**	**2**
CO5	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**3**	**3**

Course Content:

Module I: Introduction to E-Commerce (5L)

Definition, Scope of E-Commerce, Hardware requirements, E-Commerce and Trade Cycle, Electronic Markets, Electronic DatInterchange and Internet Commerce.

Module II: Business to Business E-Commerce (6L)

Electronic Markets, Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational Ecommerce. Business models for E-commerce, Business Process Re- Engineering.

Module III: Legal issues: (5L)

Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract.

Module IV: Security Issues: (7L)

Security Solutions: Symmetric and Asymmetric Cryptosystems, RSA, DES, and Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Electronic cash over internet, Internet Security, Search engines, Intelligent agents in E- Commerce Electronic payment systems, E-security

Module V: Business to Consumer E-Commerce and E-Business: (7L]

Consumer trade transaction, Web metrics, Elements of E-Commerce, Industry impacts of E-business. Integrating Intranet and internet web applications across multiple networks. Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, Virtual Auctions, Online Share Dealing, Gambling on the net, E-Diversity, Case studies through internet.

Module VI: Mobile Commerce (5L)

Overview, Infrastructure, Applications, Mobile Payment, Limitations, Security in M-Commerce, ERP and Data warehousing, ERP and E-business.

Text books:

1. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2. Handbook on Electronic Commerce, Shaw et al., Springer publication.
3. Enterprise Resource Planning –Alexis Leon, Tata McGraw Hill
4. E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH.

Reference books:

1. Applied E-Commerce, Langer, John Wiley Publication.
2. E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH.
3. Enterprise Resource Planning, 2nd Edition by Alexis Leon, Tata McGraw Hill Education, 2008.
4. Guide to Planning ERP Application, Annetta Clewwto and Dane Franklin, McGraw Hill, 1997.

Course Name: Internet of Things Lab
Course Code: ECS591
Contact: 0:0:3
Credits: 1.5

Prerequisite: Sensors, System Integration Cloud and Network Security

Course Objective(s):

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

O1: Understand internet of Things and its hardware and software components
O2: Interface I/O devices, sensors & communication modules
O3:Remotely monitor data and control devices
O4:Develop real life IoT based projects

Course Outcomes (COs):

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

CO1	Understand the concept of Internet of Things
CO2	Implement interfacing of various sensors with Arduino/Raspberry Pi.
CO3	Demonstrate the ability to transmit data wirelessly between different devices.
CO4	Show an ability to upload/download sensor data on cloud and server

CO-PO Mapping:

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	2	1	1	2	2	3	3	3	2	2
CO2	2	3	3	3	3	1	1	1	2	2	3	3	3	1	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3	2	1	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3	2	2	3

List of Experiments:

1) Definition, Characteristics, and Features of IoT.
2) Familiarization with Arduino IDE and writing a program using Arduino IDE or LED blinking.
3) Study of LM35 temperature sensors and write programs to monitor them with Arduino with Thing Speak.
4) Study of DHT-11 sensors and write programs to monitor them with Arduino with Thing Speak
5) Study of Ultrasonic sensors and write programs to monitor them with Arduino with Thing Speak
6) Study of Soil sensor and write programs to monitor them with Arduino with Thing Speak.
7) Study of PIR sensor and write programs to monitor them with Arduino with Thing Speak.

8) Familiarization with Node MCU and writing a program using it for LED blinking.
9) Study of LM35 temperature sensors and write programs to monitor them using Node MCU
10) Study of DHT-11 sensors and write programs to monitor them using Node MCU
11) Study of ultrasonic sensors and write programs to monitor them using Node MCU.
12) Study of Soil sensor and write programs to monitor them using Node MCU.
13) Study of PIR sensor and write programs to monitor them using Node MCU.
14) Setup Raspbian on the Raspberry Pi and write a program to blink an LED using Python.
15) Interfacing digital sensors and relay boards with Raspberry Pi & ESP 8266.
16) Familiarization with Python and writing programs in PyCharm IDE.
17) Define and Explain Eclipse IoT Project.
18) Introduction to Blink Application and implementation of small projects.

List of Open Source Software/learning website:

- https://github.com/connectIOT/iottoolkit
- https://www.arduino.cc/

Course Name: Lab for Object Oriented Programming using JAVA
Course Code: ECS593
Contact: 0:0:3
Credit: 1.5

Prerequisites: Basic knowledge of computer programming

Course Objective(s):

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

O1: understand the way Java programs are executed, which involves compiling the java file by using the command javac and then interpreting the class file by using the command java

O2: write basic programs in Java by using the keywords and techniques for decision making, looping, creating and manipulating arrays and strings

O3: apply the Java keywords and techniques to implement encapsulation, polymorphism, and inheritance

O4: use the techniques for exception handling (try-catch, throw, throws, finally), multithreading, and i/o managing in Java (command line argument, Scanner class, BufferedReader).

O5: write programs in Java to draw basic shapes

Course Outcomes (COs):

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

CO1	Write programs in Java by using the command prompt as well as IDEs
CO2	Write programs in Java to implement the special features-interface, generics, exception handling, and multithreading
CO3	Write programs in Java to use features of different packages of Java, particularly java.util.* and java.io.*,and create customized packages
CO4	Write graphics programs in Java

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**3**	**2**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**3**	**-**	**2**	**3**	**-**	**-**	**2**	**3**	**3**	**2**

List of experiments:

I. *Java Basics and I/O in Java*

1. Simple Java programming using operators, control statements and loops.
2. Programming on constructor, method overloading.
3. Programming on this keyword, call by value & call by reference, static variables and methods, innerclasses.
4. Programming on Command line arguments
5. Programming using keyboard input by implementing BufferedReader & Scanner classes

II. *Arrays and Strings in Java*

1. Programming for implementation of one dimensional array, two-dimensional array, and irregular array
2. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equals Ignore Case(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.
3. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods

III. *Inheritance, Interface and Java Packages*

1. Programming on Simple Inheritance, super and final keywords, super () method.
2. Programming on method overriding, abstract classes and methods; multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user- defined packageusing same names for classes of different packages, adding multiple public classes to a package.

IV. *Exception handling, Multithreading and Applet Programming:*

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. Programming on displaying simple geometric shapes by using awt and swing

Text books:

4. *Java: A Beginner's Guide* , Herbert Schildt, McGraw-Hill, 7th Ed.(or later)
5. *Programming With Java* , E. Balaguruswamy, McGraw-Hill, 6th Ed.(or later)
6. *Let us Java*, Yashavant Kanetkar and Anuj Kanetkar, BPB, 7th Ed.(or later)

Reference Books:

4. *Java: The Complete Reference*, Herbert Schildt, McGraw-Hill, 9th Ed.(or later)
5. *Art and Science of Java*, Eric Roberts, Pearson, 1st Edition (or later)
6. *Introduction to Programming Using Java*, David J.Eck,

   url: http://math.hws.edu/javanotes

Course Name: Embedded System Design Lab
Course Code: ECS593A
Contact: 0:0:3
Credit: 1.5

Prerequisites: Concept of Digital Electronics Lab, Microprocessor and Microcontroller Lab.

Course Objective(s):

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

O1: Understand Embedded System Architecture

O2: Develop Programming Skills for Embedded Platforms

O3: Interface Embedded Hardware Components

O4: Design and Implement Embedded Applications

Course Outcomes (COs):

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

CO1	Familiarization with PIC Microcontroller, ARM Microcontroller, FPGA and their interfacing.
CO2	Design of different types real time projects with digital controllers
CO3	Program ARM microcontroller to perform various tasks.
CO4	Understand the key concepts of embedded systems suchas I/O,timers, interrupts and interaction with peripheral devices.

CO-PO Mapping:

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

CO 4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**

List of Experiments:

1. PIC based experiment (Any Five)
a) Familiarization of PIC kit.
b) Interface and control a LED, LCD, Keyboard, ADC& DAC using PIC.
c) Connect two PIC kit and transfer data serially.
d) Design a Digital watch based on PIC.
c) Control a stepper motor and display temperature from atemperature sensor on a LCD.

2. ARM based experiment (Any Four)
a) Familiarization with ARM evaluation system
b) Familiarization with Raspberry Pi
c) Interfacing with a real time clock using a serial port to display time.
d) Interface a Keyboard and display the keystrokes on a LCD, LED.
Familiarization of image processing using ARM

3. FPGA based experiment
a) Design a 3 to 8 decoder circuit.
b) Design an UP/DOWN counter and display the count on a 7-segment display.
c) Designing an ALU and verify with mathematical operations.
d) Innovative Project.

Text book:

5. Embedded Systems: Architecture, Programming and Design, Raj Kamal, McGraw Hill Education, 3rd Edition, 2017
6. Embedded System Design, Frank Vahid and Tony Givargis, Wiley, 1st Edition, 2002
7. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, Pearson, 2nd Edition, 2006
8. PIC Microcontrollers: An Introduction to Microelectronics, Martin Bates, Newnes (Elsevier), 3rd Edition, 2011

Reference Books:

4. Embedded Systems: A Contemporary Design Tool, James K. Peckol, Wiley, 2nd Edition, 2019
5. Real-Time Concepts for Embedded Systems, Qing Li and Caroline Yao, CMP Books, 1st Edition, 2003
6. Programming Embedded Systems in C and C++, Michael Barr and Anthony Massa, O'Reilly Media, 2nd Edition, 2006

Course Name: Digital Signal Processing Lab
Course Code: ECS593B
Contact: 0:0:3
Credit: 1.5
Prerequisites: Analog Electronics circuit, Signals & Systems, Analog Filters.

Course Objective(s):

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

O1: To implement simulation and development of basic signal processing algorithms.

O2: To study the standardized environments such as MATLAB and general-purpose DSP development kits.

O3: To analyze and Observe Magnitude and phase characteristics of different signals.

O4: The experiments implement fundamental concepts of digital signal processing like sampling and aliasing, internal arithmetic operations, digital filter design and implementation, signal generation.

O5: Students will try to learn about the knowledge on different algorithms associated with filtering of long data sequences.

Course Outcomes (COs):

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

CO1	Understand various signals generation.
CO2	Compute the system output using convolution method with MATLAB Software package.
CO3	Analyze and Observe Magnitude and phase characteristics of different signals.
CO4	Calculate DFT, FFT, IDFT using MATLAB.
CO5	Analyze Magnitude and phase characteristics (Frequency response Characteristics) of digital LP, HP& FIR Butterworth filters.

CO-PO Mapping:

CO	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	1	1	2	1	3	1	2	3	3	2	1	2	3	3
CO2	2	1	3	1	2	3	3	2	2	3	1	2	3	3
CO3	2	3	3	2	3	3	2	1	2	3	2	3	3	2
CO4	1	2	1	3	1	2	3	3	2	2	3	1	2	3
CO5	1	1	3	3	2	3	3	2	1	2	3	2	1	2

Course Content:

Experiment 1: Sampled sinusoidal signal, various sequences and different arithmetic operations using MATLAB.

Experiment 2: Convolution of two sequences using graphical methods and using commands-verification of the properties of convolution.

Experiment 3: Z-transform of various sequences – verification of the properties of Z-transform.

Experiment 4: Twiddle factors – verification of the properties.

Experiment 5: DFTs / IDFTs using matrix multiplication and also using commands.

Experiment 6: Circular convolution of two sequences using graphical methods and using commands, Differentiation between linear and circular convolutions.

Experiment 7: Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.

Experiment 8: Implementation of FFT of given sequence.

Experiment 9: Implementation of LP & HP FIR filters for a given sequence.

Experiment 10: Hardware Laboratory: Writing & execution of small programs related to arithmetic operations and Convolution using Assembly Language of TMS320C 5416/6713 Processor.

Experiment 11: Innovative Experiment.

Text Books:

1. Digital Signal Processing: Principles, Algorithms and Applications, J. G. Proakis & D. G. Manolakis, Pearson Education, 4th Edition, 2007
2. Digital Signal Processing: A Computer Based Approach, S. K. Mitra, TMH Publishing Co., 4th Edition, 2011
3. Digital Signal Processing: Signals, Systems and Filters, A. Antoniou, TMH Publishing Co., 1st Edition, 2006
4. Discrete-Time Signal Processing, A. V. Oppenheim, R. W. Schafer, John R. Buck, Prentice Hall, 3rd Edition, 2010

Reference Books:

1. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India), 1st Edition, 2004
2. Digital Signal Processing, S. Salivahanan, A. Vallavaraj & C. Gnanapriya, TMH Publishing Co., 2nd Edition, 2010
3. Digital Signal Processing: A Hands-on Approach, C. Schuler & M. Chugani, TMH Publishing Co., 1st Edition, 2009

Course Name: VLSI & Microelectronics Lab
Course Code: ECS593C
Contact: 0:0:3
Credit: 1.5

Prerequisites: Concept of courses Solid State Devices; Analog Electronic Circuit; Digital Electronic and Circuit.

Course Objective(s):

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

O1: To understand the basic concepts of designing combinational and sequential circuits and the design of VLSI ICs.

O2: To motivate students to design VLSI circuits in the area of digital, analog.

O3: To encourage the design of IC with low power and high speed.

O4: To study various programmable logic devices like PLDs and FPGA.

Course Outcomes (COs):

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

CO1	Able to measure & analyze VIL, VIH, VOL, VOH, noise margin, gate delay and average power consumption of CMOS inverter for VDD in between 0.5V - 1.2 V using nano dimensional channel length of MOS transistor following DC &transient analysis with the help of SPICE tools.
CO2	Able to design & explain the working of basic gates-AND/NAND, OR/NOR, XOR/XNOR gate; full adder circuit; sequential circuit -SR latch, clocked SR latch & D flip-flop using CMOS design method at schematic level for the VDD range 0.5 V to 1.2 V at nano dimensional channel length with the help of SPICE tools.
CO3	Able to construct the layout & examine the functionality of CMOS inverter, CMOS NAND, CMOS NOR gate using SPICE layout design tools based on design rules for VDD0.5Vto1.2V.
CO4	Able to design combinational circuits - logic gates, half adder, full adder, 4:1 MUX using 2:1MUX ; sequential circuits-S-R flip-flop, 8-bit synchronous counter, 8-bit bi-directional register with help of behavioural , dataflow , structural & mixed modelling style through VHDL code and able to demonstrate system design using FPGA at prototype level .
CO5	Able to design CMOS differential amplifier with active load and biased with current mirror using nano dimensional channel length of MOS transistors with the help of SPICE tools at schematic level.

CO-PO Mapping:

CO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO1**	**PO1**	**PSO**	**PSO**	**PSO**

	1	2	3	4	5	6	7	8	9	0	1	1	2	3
CO1	1	3	1	2	3	3	2	2	3	3	2	3	2	2
CO2	2	1	1	1	2	1	3	1	2	3	3	2	2	1
CO3	2	1	2	1	3	1	2	3	3	2	2	3	3	2
CO4	1	1	2	3	3	2	3	3	2	1	2	3	3	2
CO5	2	2	1	2	1	3	1	2	3	3	2	2	2	2

Course Content:

Experiment 1: Simulation of CMOS inverter to plot voltage transfer characteristics(VTC) for different values of kn/kp ratio for VDD=1 V and nano dimensional channel length using SPICE.
a. Measurement of critical voltages VIL, VIH,VOL ,VOH from VTC .
b. Calculation of noise margin from critical voltages.

Experiment 2: Functional verification, measurement of gate delay and average power consumption of CMOS inverter circuit for VDD range 0.5Vto 1.2Vand with the nano dimensional channel length of MOS transistor using SPICE tools.

Experiment 3: Design and testing of functionality of the following gate and combinational circuit with the help of SPICE tools at schematic level.
a. CMOS AND/NAND, OR/NOR, XOR/XNOR gate
b. CMOS full adder circuit.

Experiment 4: Layout design and functional verification of CMOS inverter, CMOS NAND , CMOS NOR gate using layout design tools of SPICE based on design rules.

Experiment 5: Design and examination of functionality of the sequential circuits - CMOS SR latch, clocked SR latch & D flip-flop at schematic level using SPICE tools.

Experiment 6: Design and simulation of a) Logic gates b) Full adder using half adder c) 4:1 MUX using 2:1 MUX with the help of VHDL following suitable modelling style (structural, behavioral , dataflow , mixed).

Experiment 7: Design of the following Sequential circuits using VHDL a. S-R Flip-Flop b. 8 bit synchronous counter c. 8 Bit bi-directional register with tri-stated input output.

Experiment 8: Familiarity with FPGA based system design. Design and realization of 4:1Mux using FPGA.

Experiment 9: Design of CMOS differential amplifier at schematic level with active load and current mirror bias circuit for given specifications using SPICE tools .

Experiment 10: Innovative Experiment.

Text Books:

1. Digital Integrated Circuits, J. M. Rabaey, A. Chandrakasan, B. Nikolic, Pearson Education, 2nd Edition, 2003
2. CMOS Digital Integrated Circuits: Analysis and Design, S. M. Kang & Y. Leblebici, TMH, 3rd Edition, 2003

3. CMOS Analog Circuit Design, P. E. Allen & D. R. Holberg, Oxford University Press, 2nd Edition, 2002
4. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H.E. Weste & David Harris, Pearson Education, 4th Edition, 2010

Reference Books:

1. Microelectronic Circuits, Adel S. Sedra & Kenneth C. Smith, Oxford University Press, 7th Edition, 2015
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley, 1st Edition, 2002
3. VLSI Design, Debaprasad Das, Oxford University Press, 2nd Edition, 2021
4. VLSI Design and EDA Tools, Angsuman Sarkar, Swapnadip De, C.K. Sarkar, Scitech Publications, 1st Edition, 2010

Course Name: IT Workshop Lab
Course Code: IT(EC)591
Contact: 0:0:3
Credit: 1.5

Prerequisites: Basic knowledge of computers, basic knowledge of programming

Course Objective:

Enable students to use basic object-oriented features in coding. Enable students to develop small projects.

Course Outcomes (COs):

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

CO1	Apply MATLAB tools in designing programs.
CO2	Analyze different dimensions of a problem and provide optimal solutions,
CO3	Evaluate and analyze different solution in the domain of image processing and machine learning.
CO4	Develop and implement real-time applications by integrating MATLAB

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**2**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**
CO2	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**2**	**3**
CO3	**1**	**2**	**3**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**1**	**3**	**2**	**3**
CO4	**1**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**2**	**2**	**3**

Contents:

Module 1: Introduction to MATLAB

The MATLAB Environment, MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output. Vectors, Arrays – Matrices

Module 2: MATLAB Functions

Built-in Functions, User defined Functions

Module 3: Graphics with MATLAB

Files and File Management – Import/Export , Basic 2D, 3D plots , Graphic handling

Module 4: Programming with MATLAB

Conditional Statements, Loops • MATLAB Programs – Programming and Debugging. • Applications of MATLAB Programming.

Module 5: Mathematical Computing with MATLAB

Algebraic equations, Basic Symbolic Calculus and Differential equations , Numerical Techniques and Transforms

Textbooks:

1. Guide to MATLAB – for Beginners and Experienced Users, Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2nd Edition, 2006.
2. A Practical Introduction to Programming and Problem Solving, Stormy Attaway, Elsevier, 3rd Edition, 2013.

Reference books:

1. Essentials of MATLAB Programming, Stephen J. Chapman, Cengage Learning, 2nd Edition, 2009.
2. MATLAB Demystified, David McMahon, The McGraw-Hill Companies, 2007.

3rd Year 6th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS601	Computer Networks	3	0	0	3	3
2	ENGG	Major	ECS602	Machine Learning	3	0	0	3	3
3	ENGG	Major	ECS603A	Control System Engineering	3	0	0	3	3
			ECS603B	Digital Image Processing					
			ECS603C	Information Theory and Coding					
			ECS603D	Ad-Hoc and Sensor Networks					
4	ENGG	Major	ECS604A	Data Mining	3	0	0	3	3
			ECS604B	Simulation and Modelling					
			ECS604C	Cloud Computing					
			ECS604D	Optimization Techniques					
5	ENGG	Minor	EC(ECS)605A	Wireless Communication	2	0	0	2	2
			EC(ECS)605B	Nanoelectronics					
			EC(ECS)605C	Introduction to Robotics					
			EC(ECS)605D	MEMS Technology					
6	HUM	Value Added Course	HU601	Research Methodology and IPR	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ECS691	Computer Networking Lab	0	0	3	3	1.5
2	ENGG	Major	ECS692	Machine Learning Lab	0	0	0	3	1.5
3	ENGG	Major	ECS693A	Control System Engineering Lab	0	0	3	3	1.5
			ECS693B	Digital Image Processing Lab					
			ECS693C	Information Theory and Coding Lab					
			ECS693D	Ad-Hoc and Sensor Networks Lab					
4	ENGG	Major	ECS694A	Data Mining Lab	0	0	3	3	1.5
			ECS694B	Design and Simulation lab					
			ECS694C	Cloud Computing Lab					
			ECS694D	Optimization Techniques Lab					

Course Name: Computer Network
Course Code: ECS 601
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:
Introduction to computer networks and the technical foundations of the Internet, including applications, proto cols, local area networks, algorithms for routing and congestion control, security, elementary performance evaluation

Course Objective(s):
The objective of the course is to make the students able to –

1. O1: Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
2. O2: Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
3. O3: Understand the concepts of Congestion control and building the skills of sub netting and routing mechanisms.
4. O4: Acquire knowledge of Application layer paradigms and protocols.

Course Outcomes (COs):

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

CO1	Understand and explain the concept of Data Communication and networks, layered architecture and their applications
CO2	Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
CO3	Understand the concepts of Congestion control and building the skills of sub netting and routing mechanisms.
CO4	Acquire knowledge of Application layer paradigms and protocols.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PS O3
CO 1	3	2	1	-	2	-	-	-	2	2	2	3	3	3
CO	3	3	1	-	2	-	-	-	2	2	2	2	2	3

2														
CO 3	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**1**	**2**	**2**	**3**	**2**	**3**
CO 4	**3**	**1**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**1**	**2**	**2**	**2**	**2**

Course Content:

Module 1:
Overview of Data Communication and Networking: (4L)
Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.
Physical Level: (6L)
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: (5L)
Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC;
Medium Access sub layer:
(5L)

Point to Point Protocol, LCP, NCP, Token Ring; Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, Fast Ethernet (in brief);

Module 3:
Network layer: (8L)
Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, sub-netting; Routing: techniques, static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6;.

Module4: Application Layer (5L)

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls.
Modern topics: (3L)
ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief Wireless LAN: IEEE 802.11.

Text book:
1. B.A. Forouzan–"Data Communications and Networking(3rdEd.)" –TMH

2. A.S. Tanenbaum–"Computer Networks (4thEd.)"–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: Machine Learning
Course Code: ECS602
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of basic computer science principles and skills familiarity with the basic probability theory and basic linear algebra.

Course Objective(s):

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

1. O1: Acquire theoretical knowledge on setting hypothesis for pattern recognition.
2. O2: Apply suitable machine learning techniques for data handling and knowledge extraction.
3. O3: Evaluate the performance of algorithms
4. O4: Provide solutions for various real-world applications.

Course Outcomes (COs):

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

CO1	Recognize the characteristics of machine learning that make it useful to real-world problems
CO2	Characterize machine learning algorithms as supervised, semi-supervised and unsupervised.
CO3	Be able to use support vector machines
CO4	Understand the learning algorithm for hidden Markov model with latent variables

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**3**	**3**	**3**
CO2	**-**	**-**	**-**	**3**	**-**	**--**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO3	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**3**
CO4	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**3**

Course Content: **(8L)**

Module 1: Basics of Linear Algebra: Introduction to Machine Learning, linear classification, perceptron update rule, Perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization.

Module 2: Logistic Regression **(9L)**

Linear regression, estimator bias and variance, active learning, Active learning, non-linear predictions, Regression/Classification Basic methods: Distance-based methods, Nearest Neighbors, Decision Trees, Kernel regression, kernel optimization, Model selection criteria, Description length, feature selection, expectation maximization

Module 3: Classification **(10L)**

Classification problems; decision boundaries; nearest neighbor methods, Probability and classification, Naive Bayes, Bayes' Rule and Naive Bayes Model, Hidden Markov models (HMMs), Bayesian networks, Learning Bayesian networks, Logistic regression, online gradient

descent, neural network, Support Vector Machine (SVM), Kernel Ridge Regression.

Module 4: Introduction to Deep Learning (9L)

Definition, Need of Deep Learning, Different Techniques: ANN, CNN, Recursive Neural Deep Model, Framework: Tensor flow, Tensor flow light

Text book:

1. Shai Shalev-Shwartzand, Shai Ben- David, "Understanding Machine Learning, Cambridge University Press.
2. Christopher M. Bishop, "Pattern recognition and machine learning", Springer.
3. Richard O Duda, Peter E. Hart & David G. Stock, "Pattern Classification", John Wiley.
4. S. Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy logic and Genetic Algorithm: Synthesis and Applications, Pearson Education.
5. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Pearson, Third Edition, 2014.

Reference book:

1. Konstantinos Koutroumbas, Sergios Theodoridis,, "Pattern Recognition", Elsevier.
2. Simon Haykin, Neural Networks- A Comprehensive Foundation, Prentice Hall.
3. B. Yegnanarayana, Artificial Neural Networks, PHI.
4. Friedman Jerome, Trevor Hastie, and Robert Tibshirani. The Elements of Statistical Learning. Springer-Verlag, 2nd Edition, 2013.
5. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Course Name: Control System Engineering
Course Code: ECS603A
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites: Concepts in electrical circuits (Studied in Basic Electrical), Fundamental concepts on Laplace Transformation (studied in Mathematics).
Course Objective(s):
The objective of the course is to make the students able to –

O1: Introduce concepts of mathematical modelling, open loop and feedback control systems.
O2: Employ time domain analysis to predict and diagnose transient performance parameters of different types of systems for standard input signals.
O3: Understand the various techniques of stability analysis in the time and frequency domain.
O4: Identify the needs of different types of controllers and compensators to meet the required dynamic response from the system.

Course Outcomes (COs):

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

CO1	Understand mathematical models of physical systems and study their nature, configuration and relevant mapping into equivalent models.
CO2	Determine the time responses of different types of systems and time domain specifications.
CO3	Analyze and solve stability-related issues in time response, and stability analysis using root locus.
CO4	Evaluate the relative stability of control systems using frequency domain analysis.
CO5	Design controllers according to desired performance specifications.

CO-PO Mapping:

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

Course Content:

Module 1: INTRODUCTION TO CONTROL SYSTEMS &MODELLING
(7L)

Basic Elements of Control System, Linear, Non-Liner and Discrete Time System (Introduction & Concept) Open loop and Closed loop systems – Differential equation on control system – About transfer function and its generation technique, Modeling of Electrical and mechanical systems - Block diagram reduction techniques - Signal flow graph, mason's gain formula.

Module 2: TIME RESPONSE ANALYSIS (5L)

Time response analysis –Different input deterministic test response – Order and Type of the incorporation of the systems with time response: First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors and error constants.

Module 3: STABILITY ANALYSIS (7L)

Routh -Hurwitz Criterion, Root Locus Algorithm, Construction of Root Locus, Effect of addition of pole and zero on the root locus, Application of Root Locus Diagram.

Module 4: FREQUENCY RESPONSE ANALYSIS (8L)

Concept of Frequency Response of a system, Bode Plot Computational Algorithm, Construction of Bode diagram, Polar Plot, Phase and gain margin, Nyquist Plot, Interpretation of Bode and Nyquist plot, Stability analysis using frequency domain specifications.

Module 5: CLASSICAL CONTROL DESIGN TECHNIQUES (3L)

Introduction to P, PI, PD and PID Controllers. Introduction to lead, lag and lead-lag compensators.

Module 6: STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS (6L)

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties – Concepts of Controllability and Observability. Concept of state feedback.

Text book:

1. B. C. Kuo , "Automatic Control Systems", 8th edition, 2003– John Wiley and son's.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 2nd edition.
3. Norman S. Nise, "*Control Systems Engineering",* John Wiley and son's.
4. Ramesh Babu , "Control System Engineering", Scitech.

Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd, edition, 1998.
2. Richard C. Dorf , "Modern Control Systems", Global Edition.
3. N.K.Sinha, "Control Systems" New Age International (P) Limited Publishers, 3rdEdition, 1998.
4. Narciso F. Macia George J. Thaler, "Modeling & Control of Dynamic Systems", Thomson Publishers.

Course Name: Digital Image Processing
Course Code: ECS603B
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites:
Concepts of Digital Signal Processing. Some portion of mathematics like Linear algebra, calculus, probability, Fourier. In Programming Python or MATLAB. Some more concepts on image manipulation libraries Image Concepts Pixels, color spaces, resolution, histograms.

Course Objective(s):

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

O1: To become familiar with digital image fundamentals
O2: To learn Transform of Digital Images and its applications.
O3: To get familiar with simple image enhancement techniques in both spatial and frequency domain.
O4: To become familiar with image compression and recognition methods
O5: To learn concepts of image restoration techniques and image segmentation and representation techniques.
O6: To study the Edge detection in Digital Image Processing.
O7: To become familiar with basics of Security in Digital Image Processing

Course Outcomes (COs):

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

CO1	Have a clear idea on Digital Imaging fundamentals and Importance of Digital Image Transform.
CO2	Understanding the importance of Digital Image enhancement in spatial and frequency domain and filtering techniques
CO3	Explaining the requirements and types of Image Compression and its standards.
CO4	Demonstrate the basic concepts of Digital Image Restoration and Segmentation of Digital Images
CO5	Familiarize with Edge detection techniques and concepts on security in Digital Image Processing

CO-PO Mapping:

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

Course Content:

Module 1: Digital Imaging Fundamentals (8L)

Basic idea of Digital image, Image formation in human eye, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing.
Transform of Digital Images**:** Importance of Digital Image Transform, Fourier Transform of Digital Image (DFT), Inverse Fourier Transform (IDFT), Fast Fourier Transform, Inverse Fast Fourier Transform, Application of Digital Image Transform in different area

Module 2: Digital Image Enhancement: (6L)

Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Bit plane slicing, Histogram, Histogram Equalization , Mean and Median filtering in Digital Images, Frequency domain filtering in Digital Images – LPF, HPF and BPF

Module 3: Digital Image Compression: (6L)

Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, compression using Huffman coding, DCT and Wavelet based Digital image compression

Module 4: Digital Image Restoration: (8L)

Application and Importance of Digital Image Restoration, Reason for Image degradation, Inverse filtering. Segmentation of Digital Images: Importance and applications of Digital Image Segmentation, Detection of discontinuities, Edge linking and Boundary detection, Thresholding, Segmentation based on Region Growing, Watershed algorithm.

Module 5: Edge detection in Digital Image Processing: (8L)

Importance of Edge detection in Digital Image Processing, Types of Edge Detection, Mathematical Equation of each operator.Security in Digital Image Processing: Importance of Digital Image Security, Watermarking, Image encryption in spatial and frequency domain, Steganography.

Text books:

1. Digital Image Processing, Rafael C. Gonzales, Richard E. Woods, Pearson Education, 3rd Edition, 2010.
2. Fundamentals of Digital Image Processing, S. Annadurai, R. Shanmugalakshmi, Pearson Education, 2nd Edition, 2006
3. Fundamental of Digital Image Processing, Anil K Jain, Prentice Hall, 1st Edition, 1989
4. The essential guide to image processing, A C. Bovik, Academic Press, 2nd Edition, 2009
5. Digital Video Processing, M. Teckalp, Prentice Hall PTR, Special Edition, 1995

Reference books:

1. Digital Image Processing, Willliam K Pratt, John Willey, 2nd Edition, 2002.
2. Digital Image Processing and Pattern Recognition Malay K. Pakhira, PHI Learning Pvt. Ltd., First Edition, 2011.
3. Fundamentals of Digital Image Processing, A.K.Jain, Prentice Hall India, Special Edition, 2017.
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Tata Mc Graw Hill Pvt. Ltd., 3rd Edition, 2011.
5. Fundamentals of Digital Image Processing, Anil Jain K., PHI Learning Pvt. Ltd., 1st Edition, 2011.
6. Digital Image Processing Madhuri.A.Joshi, Prentice Hall India, 1st Edition, 2013
7. Analysis of Image Processing and Machine Vision, Sonka, Spec Cengage Publications, 1st Edition, 2008.

Course Name: Information Theory & Coding
Course Code: ECS603C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites: Digital Electronics & probability.

Course Objective(s):

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

O1: Introduce concepts of information theory and various source coding techniques.
O2: Calculate channel capacity and rate of information in the digital communication system.
O3: Apply source coding techniques to compress and encrypt data.
O4: Implement various error detection and correction coding techniques in the communication system to solve problems.

Course Outcomes (COs):

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

CO1	Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.
CO2	Understand the basic concept of coding theory and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CO3	Understand the concept of channel models to determine the mutual information in the channels.
CO4	Outline the concept of 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 to solve it by means of existing and new methods as a team work.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	1	-	-	-	-	-	-	3	3	2
CO2	2	3	3	-	3	--	-	-	-	-	-	3	3	2
CO3	2	3	3	3	3	-	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	-	-	-	-	-	2	2	2
CO5	3	3	3	2	2	2	-	-	-	-	1	2	2	2

Course Content:

Module 1: Source Coding (6L)

Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes. Shannon - Fano Coding.

Module 2: Channel Capacity and Coding (6L)

Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module 3: Linear and Block Codes for Error Correction (8L)

Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block. Standard array and syndrome detection code, perfect codes, Hamming codes.

Module 4: Cyclic Codes (8L)

Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, decoding cyclic codes, Encoding and Decoding circuit

Module 5: Other Codes (8L)

Convolutional Codes: Encoding, state diagram, Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, Viterbi decoding, examples of convolutional codes.

Text book:

1. Ranjan Bose, "Information theory, coding and cryptography", TMH.
2. Salvatore Gravano, "Introduction to Error Control Codes", Oxford
3. A Saha, S Mondal, "Information theory, coding and cryptography", Pearson.
4. Todd K Moon,- Error Correction Coding: Mathematical Methods and Algorithms, John Wiley & Sons

Reference Books:

1. N Abramson;, "Information and Coding", McGraw Hill.
2. M Mansurpur , "Introduction to Information Theory", McGraw Hill.
3. R B Ash, "Information Theory", Prentice Hall.
4. Shu Lin and D J Costello Jr; , "Error Control Coding", Prentice Hall.

Course Name: Ad-Hoc and Sensor Networks
Course Code: ECS603D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites:
The students should have the basic knowledge of communication and networks.
Course Objective(s):
The objective of the course is to make the students able to –

O1: Provide an overview about sensor networks and emerging technologies and to study about the node and network architecture of sensor nodes and its execution environment.
O2: To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN
O3: To learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control.
O4: To study about sensor node hardware and software platforms and understand the simulation and programming techniques

Course Outcomes (COs):

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

CO1	Understand the fundamentals of wireless sensor networks and its application.
CO2	Study the various protocols at various layers and its differences with traditional protocols.
CO3	Realize the issues pertaining to sensor networks and the challenges.
CO4	Employ appropriate sensor nodes to perform engineering tasks and scientific researches

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	2	-	-	2	1	2	2	2	2
CO2	3	3	3	2	2	2	-	-	2	1	2	2	2	2
CO3	3	3	3	2	2	2	-	-	2	1	2	2	2	2
CO4	3	3	3	2	2	2	-	-	2	1	2	2	2	2

Course Content:

Module 1: Introduction and Overview (6L)

Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.

Module 2: Architectures Single-node architecture (6L)

Hardware components, design constraints, energy consumption of sensor nodes , operating systems and execution environments, examples of sensor nodes, sensor network scenarios, types of sources networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design principle.

Module 3: Communication Protocols (12L)

Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts - S-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols-classification, gossiping, flooding, energy efficient routing, unicast protocols, multi path routing, data-centric routing, data aggregation, SPIN, LEACH, Directed Diffusion, geographic routing.

Module 4: Infrastructure Establishment (6L)

Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control

Module 5: Sensor Network Platforms and Tools (6L)

Sensor node hardware, Berkeley motes, programming challenges, node level software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.

Text book:

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An 16 PG Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, and Applications”, John Wiley, 2007.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

Course Name: Data Mining
Course Code: ECS604A
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3
Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence
Course Objective(s):

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

O1: Provide a comprehensive and well-rounded education in data mining.
O2: Apply suitable covering theoretical foundations & ethical considerations.
O3: Evaluate technical skills, communication, project management, financial aspects, and practical applications

Course Outcomes (COs):

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

CO1	Understand and explain the essential concepts of Data Mining technologies, recognizing their practical relevance in the current tech landscape, fostering exploration for lifelong learning
CO2	Identify and formulate an engineering problem within the scope of Data Mining paradigm.
CO3	Explore relevant literature and apply the concepts of Data Mining to solve problems of making automated decisions dealing with huge amounts of data..
CO4	Develop ideas for proposing solutions to the challenging problems of Data Mining.
CO5	Implement ideas of Data Mining through developing feasible algorithms or frameworks and investigate their effectiveness by analyzing the performances in solving the relevant problems.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to Data Mining (10L)

Basic Concepts, Data Exploration: Data Types, Data Attributes, Statistical Description of Data, Data Visualization and Data Similarity Measure. Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization.

Module 2: Mining Frequent Patterns, Associations and Correlation Analysis (8L)

Basic Concepts, Frequent Item set 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

Module 3: Classification and Regression (8L)

Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naive Bayes Classifier ANN-Back propagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods

Module 4: Clustering and Outlier Analysis (10L)

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

Text book:

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.
3. Hongbo Du, "Data Mining Techniques and Applications: An Introduction", Cengage Learning India Private Limited

Reference book:

1. Pang-Ning Tan, Vipin Kumar, Michael Stein Banch, "Introduction to Data Mining", Pearson Education
2. Robert Layton, "Learning Data Mining with Python", Packet Publishing

Course Name: Simulation and Modelling
Course Code: ESC604B
Contact: 3:0:0
Total Contact Hours: 36
Credit:3
Prerequisites:

To successfully understand and apply the concepts in Simulation and Modelling, students should have prior knowledge in the following areas: **Probability and Statistics, Signals and Systems, Mathematics for Engineers, Programming Fundamentals, Basic Communication Systems**

Course Objective(s):

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

O1: introduce the fundamental concepts of system modeling and simulation
O2: enable students to distinguish between different types of simulation models
O3: impart knowledge of random processes and statistical tools used in simulation
O4: develop skills in modeling communication and electronic systems
O5: train students in using modern simulation tools and platforms
O6: teach the process of validating, verifying, and analyzing simulation models
O7: prepare students for research and design through simulation-based analysis

Course Outcomes (COs):

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

CO1	Understand the principles of system modeling and different types of simulation techniques
CO2	Analyze and simulate real-time electronic and communication systems using appropriate models
CO3	Generate and evaluate random variables using statistical tools and apply them in simulations
CO4	Design discrete-event simulation models for queuing and network systems
CO5	Validate and verify simulation results and perform sensitivity and performance analysis
CO6	Use simulation software (e.g., MATLAB/Simulink) for modeling and solving engineering problems

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2	1
CO2	3	3	-	2	2	-	-	-	-	2	1	3	2	1
CO3	3	3	-	2	3	-	-	-	-	1	1	3	2	1
CO4	3	3	3	3	3	-	-	-	-	1	2	2	2	2
CO5	3	3	0	3	3	-	-	-	-	2	2	2	2	2

CO6	3	3	0	3	3	-	-	-	-	-	2	2	2	2

Course Content:

Module 1: Introduction to Simulation (7L)

Systems, Models, and Simulation ,Need and Types of Simulation Continuous vs Discrete Systems, Deterministic vs Stochastic Models, Mathematical Models and Modeling Approaches Steps in Simulation Study.

Module 2: System Dynamics & Random Number Generation (7L)

System Dynamics Concepts, Causal Loop Diagrams, Stock and Flow Models, Generation of Random Numbers, Tests for Randomness (Chi-Square, KS Test), Random Variate Generation for Discrete and Continuous Distributions.

Module 3: Queuing Models and Discrete Event Simulation (8L)

Introduction to Queuing Theory, M/M/1, M/M/c, M/G/1 models, Applications in Communication Systems, Discrete Event Simulation (DES), (Event SchedulingTime Advance Mechanism, Simulation Languages (e.g., GPSS, Arena)).

Module 4: Simulation of Communication Systems (7L)

Modeling of Digital Communication Systems, Error Sources: Noise, Fading BER Estimation via Monte Carlo Simulation, Modulation Techniques (BPSK, QPSK) Simulation, Channel Models (AWGN, Rayleigh, Rician).

Module 5: Verification, Validation, and Analysis (7L)

Verification and Validation (V&V) of Models, Confidence Intervals and Hypothesis Testing Sensitivity Analysis, Output Data Analysis: Time Series and Spectral Analysis, Use of MATLAB/Simulink, Python, or NS2/NS3.

Text Books

1. "Discrete-Event System Simulation" by Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, Pearson Education, 5th Edition, 2010.
2. "System Simulation with Digital Computer" by Narsingh Deo, Prentice-Hall of India (PHI Learning Pvt. Ltd.), 1st edition, 1979.
3. “System Simulation” by Geoffrey Gordon, Prentice-Hall of India (PHI Learning Pvt. Ltd.), 2nd edition, 1978.
4. “Simulation Modeling and Analysis” by Averill M. Law and W. David Kelton, McGraw-Hill Education, 5th edition, 2014.
5. “Modeling and Simulation of Systems Using MATLAB and Simulink” by Devendra K. Chaturvedi, CRC Press (Taylor & Francis Group), 1st edition, 2017.

Reference Books

1. "Simulation Modelling and Analysis" by Averill Law and W. David Kelton, McGraw-Hill Education, 5th edition, 2014.
2. “Principles of Modeling and Simulation” by John A. Sokolowski & Catherine M. Banks, Wiley (John Wiley & Sons, Inc.)1st edition, 2009.
3. “Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica” by Peter Fritzson, Wiley-IEEE Press1st edition, 2011
4. “Modelling and Simulation” by V. P. Singh, University Science Press (An imprint of Laxmi Publications Pvt. Ltd.)1st edition, 2009.

Course Name: Cloud Computing
Course Code: ECS604C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:
Basic Understanding of IT and Computing Concepts: Knowing the basics of computing, networking, and IT infrastructure helps. Familiarity with programming languages like Python, Java is beneficial. Knowledge of Cloud Platforms like Experience with Virtualization: Knowing virtualization technologies can help grasp cloud concepts faster.

Course Objective(s):

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

O1: To define Cloud Computing
O2: To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
O3: To expose the students to the frontier areas of Cloud Computing
O4: To motivate students to do programming and experiment with the various cloud computing environments
O5: To shed light on the Security issues in Cloud Computing
O6: To introduce about the Cloud Standards

Course Outcomes (COs):

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

CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc
CO3	Explain the core issues of cloud computing such as security, privacy, and interoperability.
CO4	Provide the appropriate cloud computing solutions and recommendations according to the applications used.
CO5	Collaboratively research and write a research paper, and present the research online.

CO-PO Mapping:

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

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

Course Content:

Module 1:History of Centralized and Distributed Computing: (8L)

Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.

Module2: Introduction to Cloud Computing: (8L)

Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data- storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .

Module 3: Service models: (6L)

Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies – Anything as a service (XaaS).

Module 4: Cloud Programming and Software Environments: **(7L)**

Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment.

Module 5: Cloud Access: (7L)

Authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.

Text Books:

1. Distributed and cloud computing from Parallel Processing to the Internet of Things, Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Morgan Kaufmann Press, Elsevier, 2nd Edition, – 2012
2. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , 1st Edition, New Delhi – 2010

3. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller, Que Publisher, Special Edition, 2008
4. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2nd Edition 2010
5. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski - John Wiley & Sons, Inc. , 1st Edition, 2011

Reference Books:

1. Cloud Computing Bible, Barrie Sosinsky, - John Wiley & Sons, 2nd Edition 2010
2. Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly Publ, 1st Edition, 2009
3. Cloud Computing Implementation, Management and Security, John Witing-house jamesF.Ransome, CRC Press, Special Edition.
4. Handbook of Cloud Computing, Borko Furht. Armando Escalante, Springer, Special Edition, 2010
5. Cloud Revolution, Charles Badcock, TMH, Special Edition, 2012

Course Name: Optimization Techniques
Course Code: ECS604D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Objective(s):

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

O1: To teach principles, concepts and applications of optimization techniques.
O2: To introduce the task of data mining as an important phase of knowledge recovery process
O3: Frame engineering minima maxima problems in the framework of optimization problems.

Course Outcomes (COs):

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

CO1	Cast engineering minima/maxima problems into optimization framework.
CO2	Learn efficient computational procedures to solve optimization problems.
CO3	Use MATLAB to implement important optimization methods.
CO4	Model engineering minima/maxima problems as optimization problems.

CO-PO Mapping:

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

Course Content:

Module 1: Mathematical preliminaries **(10L)**
Linear algebra, matrices, Vector space, eigen analysis, Elements of probability theory, Elementary multivariable calculus

Module 2: Linear Programming **(10L)**
Introduction to linear programming model, Simplex method, Duality, Karmarkar's method

Module 3: Unconstrained optimization (10L)
One-dimensional search methods, Gradient-based methods, Conjugate direction and quasi-Newton methods

Module 4: Constrained Optimization (6L)
Lagrange theorem, FONC, SONC, and SOSC conditions

Text book:
1. Edwin P K Chong, Stainslaw Zak , "An introduction to Optimization", Wiley-Interscience Series in Discrete Mathematics and Optimization.
2. Dimitri Bertsekas , "Nonlinear Programming", Athena Scientific, Belmont, Massacheuttes.
3. Niclas Andr´easson, Anton Evgrafov, and Michael Patriksson, "An Introduction to Optimization: Foundations and Fundamental Algorithms".

Reference book

1. Wu-Sheng Lu, Stanislaw H. Zak, "An Introduction to Optimization: With Applications to Machine Learning", John Wiley and Sons Ltd.

Course Name: Wireless Communication
Course Code: EC(ECS)605A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Analog and Digital Communication

Course Objectives:

O1: Know the characteristic of wireless channel.
O2: Learn the various cellular architectures.
O3: Understand the concepts behind various digital signaling schemes for fading channels.
O4: Be familiar the various multipath mitigation techniques.
O5: Understand the various multiple antenna systems.

Course Outcomes (COs):

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

CO1	Summarize the basics of cellular system and cellular design fundamentals.
CO2	Describe the wireless channel models and discuss capacity of wireless channels.
CO3	Analyse the performance of the modulation techniques for flat-fading channels and multicarrier modulation.
CO4	Illustrate how receiver performance can be enhanced by various diversity techniques.
CO5	Identify advantages of various equalization techniques and multiple-access techniques in wireless communication.
CO6	Calculate system parameters such antenna height, range, maximum usable frequency in different modes of radio wave propagation.

CO-PO mapping:

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

Course Content:

Module 1: **Introduction to Wireless Communication Systems** **(7 L)**

Generations: 2G, 3G, 4G, 5G. Wireless LAN, Bluetooth and Personal Area networks, Broadband Wireless Access - WiMAX Technology. Wireless Spectrum allocation, Standards. Frequency Reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, trunking and grade off service, improving coverage and capacity – cell splitting, sectoring, microcells.

Module 2: **Wireless Channels** **(7 L)**

Free space path loss, Two-Ray model, Shadowing, Time-varying channel impulse response, Narrowband fading, Wideband fading models, Delay spread and Coherence bandwidth, Doppler spread and Coherence time, Flat fading versus frequency selective fading, Slow fading versus fast fading, Discrete-time model. Review of Capacity in AWGN, Capacity of flat fading channel – Ergodic capacity, Capacity with Outage, Capacity with CSI-R. (Derivations of capacity formulae are not required; Only expressions, computations and significance required.)

Module 3: **Modulation techniques** **(7 L)**

Analysis of Average Error Probability and Outage probability of BPSK in flat-fading channels. Data transmission using multicarrier modulation for frequency-selective fading channels. Overlapping subchannels, Mitigation of Subcarrier Fading, Discrete Implementation of multicarrier – OFDM. Cyclic prefix, Peak-to average- power-ratio.

Module 4: **Diversity, Equalization, and Multiple Access** **(8 L)**

Receiver diversity – selection combining, maximal ratio combining. Transmitter diversity – Alamouti scheme for 2x2 MIMO. Equalization – Linear and non-linear equalization, Zero forcing, MMSE equalizers. LMS algorithm. Adaptive Equalization.
Uplink and Downlink, Multiple Access, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Orthogonal Frequency-Division Multiple Access (OFDMA).

Module 5: **Radio Wave Propagation** **(7 L)**

Ground wave propagation, Plane earth reflection, Space wave and surface wave, Spherical earth propagation, Tropospheric waves, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.

Text book:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2. Theodore S. Rappaport, Wireless communication: Principles and Practice, 2/e, Pearson Education, 1990.
3. Aditya Jagannatham, Principles of Modern Wireless Communication Systems, Mc Graw Hill, 2017.
4. Robert Collin, Antennas and Radio wave Propagation, McGraw Hill, 2016.

Reference Books:

1. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005.
2. Jochen Schiller, Mobile Communications, Pearson, 2008.
3. Andreas F Molish , Wireless Communications, 2nd Edition , Wiley India Publications, 2013.
4. W. C. Y. Lee, Mobile Cellular Telecommunication, McGraw Hill, 2013.
5. Gordon L. Stuber, Principles of Mobile Communication , Springer,2017.
6. Rahim Thafazoli, Technologies for The Wireless Future , Volume 2 , Wiley and Sons , 2004.
7. Edward C Jordan and Keith G Balmain, Electromagnetic Wave and Radiating System, Pearson.

Course Name: Nano electronics
Course Code: EC(ECS)605B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite:
The candidates should have the basic knowledge of materials physics and charge transport phenomena in electronic devices and also need basic knowledge of basic electronics like BJT and FET.

Course Objective(s):

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

1. O1:To get knowledge on various aspects of nano-technology and the processes
2. O2: To get knowledge on advantages of the nano-materials and appropriate use.
3. O3: To analysis various aspects of nano-technology for making nano components and material.
4. O4: To explain of nano-materials and appropriate useproblems

Course Outcomes (COs):

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

CO1	Develop a fundamental knowledge of nanomaterials.
CO2	Understand the recent trends of microelectronics and nano-electronics.
CO3	Know about the fabrication and analytical techniques of nanomaterials.
CO4	Understand the quantum transport phenomena and working principles of nano-electronic devices

CO-PO-PSO Mapping:

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

Course Content:

Module 1 **(8L)**

Introduction to nano-electronics, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics. Mesoscopic physics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence. Classification of Nano structures, Low dimensional structures: Quantum wells, wires and dots, Density of states and dimensionality. Basic properties of two-dimensional semiconductor nanostructures, carbon nano tube and graphene.

Module 2 **(8L)**

Introduction to methods for fabrication of nano-layers, different approaches, physical vapor deposition, chemical vapor deposition. Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods. Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self-assembly, precipitation of quantum dots.

Module 3 **(6L)**

Introduction to characterization of nanostructures, tools used for of nano materials' characterization, Microscope- optical and electron microscope. Principle of operation of Scanning Tunneling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope. X-Ray Diffraction analysis, UV-Vis spectroscopy, Particle size analyzer.

Module 4 **(8L)**

Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Piezoresistivity, Piezoelectricity and thermoelectricity,

Module 5 **(6L)**

Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single- Electron Transistor: Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Coulomb Blockade in a Nanocapacitor, Hot electro transistors, Molecular SETs and Molecular Electronics

Text Books

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.
3. T. Fukada &W.Mens, Micro Mechanical system Principle & Technology, Elsevier.
4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices.

Reference Books

1. Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springe
2. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill.
3. Nanotechnology: Synthesis to Applications by Roy, Ghosh and Sarkar, CRC Press, 2017.

Course Name: Introduction to Robotics
Course Code: EC(ECS)605C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

Concepts of mechatronics engineering, Basic Mathematics, matrices, differential equations is required. A solid foundation in mathematics and physics is essential for an introduction to robotics. Specifically, understanding linear algebra, calculus, and mechanics will be beneficial. Some programming experience, particularly with languages like Python or C++, is highly recommended.

Course Objective(s):

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

1. O1. Understand and discuss the fundamental elementary concepts of Robotics.
2. O2. Provide insight into different types of robots.
3. O3. Explain intelligent module for robotic motion control.
4. O4. Educate on various path planning techniques.

O5. Illustrate the working of innovative robotic devices

Course Outcomes (COs):

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

CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications
CO2	Identify and describe the components and anatomy of robotic system.
CO3	Know about various path planning techniques and analyze different motions of robotics system
CO4	Use the suitable drives and end-effectors for a given robotics application.
CO5	Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction To Robotics: (7L)

Introduction to Robotics and Automation, laws of robot, brief history of robotics, basic components of robot, robot specifications, classification of robots, human system and robotics, safety measures in robotics, social impact, Robotics market and the future prospects, advantages and disadvantages of robots.

Module 2: Robot Anatomy And Motion Analysis: (7L)

Anatomy of a Robot, Robot configurations: polar, cylindrical, Cartesian, and jointed arm configurations, Robot links and joints, Degrees of freedom: types of movements, vertical, radial and rotational traverse, roll, pitch and yaw, Wok volume/envelope, Robot kinematics: Introduction to direct and inverse kinematics, transformations and rotation matrix.

Module 3: Robot Drives And End Effectors: (7L)

Robot drive systems, Hydraulic, Pneumatic and Electric drive systems, classification of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive gripper, gripper force analysis and gripper design, 1 DoF, 2 DoF, multiple degrees of freedom robot hand, tools as end effectors, Robot control types: limited sequence control, point-to-point control, playback with continuous path control, and intelligent control.

Module 4: Path Planning: (8L)

Definition-Joint space technique, Use of P-degree polynomial-Cubic, polynomial- Cartesian space technique, parametric descriptions, straight line and circular paths, position and orientation planning.

Module 5: Robotics Applications: (7L)

Material Handling: pick and place, palletizing and depalletizing, machining loading and unloading, welding & assembly, Medical, agricultural and space applications, unmanned vehicles: ground, Ariel and underwater applications, robotic for computer integrated manufacturing. Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, Humanoids, Robots, Autonomous robots, and Swarm robots

Text Books:

1. Robotics Technology and flexible automation, S.R. Deb, Tata McGraw-Hill Education, 1st Edition, 2009.
2. Industrial Robots - Technology, Programming and Applications Mikell P. Groover et. al., McGraw Hill, Special Edition, 2012.
3. A textbook on Industrial Robotics, Ganesh S Hegde, University science press, 3rd Edition, 2017.
4. Robotics : Fundamental Concepts and Analysis, Ghosal A, Oxford University Press, 2nd Edition, 2006
5. Introduction to Robotics, S. K. Saha, Tata McGraw Hill Education Pvt. Ltd., 2nd Edition, 2020.
6. Robotics and Control, R. K. Mittal, I. J. Nagrath, Tata McGraw-Hill Publishing Company Ltd., 5th Edition, 2018
7. Introduction to Robotics – Mechanics and Control , J. J. Graig, Pearson Education, Inc., 2nd edition,
8. ROBOTICS – Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzalez, and C. S. G. Lee,

McGraw-Hill Book Company, 3rd Edition, 2019.
9. Introduction to Robotics – Analysis, Control, Applications, Saeed Niku, John Wiley & Sons, Special Edition, 2016

Reference Books:

1. Robotics Engineering – An Integrated Approach, Richard D Klafter, Thomas A Chmielewski, Michael Negin, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2nd Edition, 2006.
2. Robotics: Control, Sensing, Vision and Intelligence, Fu K S, Gonzalez R C, Lee C.S.G, McGraw Hill, 1st Edition, 1987.
3. A Robot Engineering Textbook, Mohsen Shahinpoor, Harper and Row, 1st Edition, New York, 1987
4. Fundamentals of Robotics – Analysis & Control, Roboert J. Schilling, Prentice-Hall of India Pvt. Ltd., Special Edition, 1990
5. Robotics Technology and Flexible Automation, S. R. Deb and S. Deb, Tata McGraw Hill Education Pvt, Ltd., 2nd Edition, New Delhi, 2020.

Course Name: MEMS Technology
Course Code:EC(ECS)605D
Contact:3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: 1. Sensor and Transducers
2. Mechanics

Course Objective(s):

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

O1: introduce the fundamentals of MEMS and microfabrication.
O2: study the essential material properties relevant to MEMS.
O3: explore various sensing and transduction techniques used in MEMS.
O4: understand the different fabrication and machining processes involved in MEMS.
O5: gain knowledge about polymer-based MEMS and optical MEMS.

Course Outcomes (COs):

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

CO1	Be familiar with the important concepts applicable to MEMS
CO2	Be familiar with the important concepts MEMS fabrication.
CO3	Be fluent with the design, analysis and testing of MEMS.
CO4	Apply the MEMS for different applications.

CO-PO Mapping:

CO	PO1	PO2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	3	1	2	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	1	3	2	-	-	-	-	-	-	-	-	-

Module 1: Introduction to MEMS and Advanced Microfabrication: (7L)

Evolution and History of MEMS, Characteristics of MEMS: Miniaturization, microelectronics integration, Precision batch fabrication, reliability, and scalabilityOverview of Microfabrication

Techniques: Traditional silicon-based MEMS processes, Emerging non-silicon processes (e.g., glass, polymer, metal), 3D MEMS structures, multi-material integration, Design considerations: Biocompatibility, flexibility, energy efficiency, Introduction to MEMS design tools and software (e.g., CoventorWare, COMSOL)

Module 2: Advanced Electrical and Mechanical Properties of MEMS Materials (7L)

Semiconductor conductivity: modern dopant control, nanowire behavior, Crystal plane orientation in MEMS etching and design, Stress and strain: Stress engineering in nanostructures, Impact of residual and thermal stress, Mechanical behavior of emerging thin-film materials (e.g., graphene, MoS_2), Flexural and torsional beam mechanics: Multi-load condition analysis, Fatigue and failure prediction, Resonance, damping, and quality factor in vacuum/microfluidic environments

Module 3: Modern Sensing and Actuation Techniques (8L)

Electrostatic: MEMS capacitive sensors for IoT and wearable tech, Updated comb drive designs for micro-robotics
Thermal: Smart thermal sensors with temperature compensation, Application in IR imaging, gas sensing
Piezoresistive: Nano-piezoresistive materials, flexible substrates, Biomedical pressure/tactile sensors
Piezoelectric: Lead-free piezo materials (e.g., AlN, $BaTiO_3$), Applications in energy harvesting and haptic feedback
Magnetic: Hybrid magnetic-electrostatic actuators, Thin-film deposition of soft and hard magnetic materials
Optomechanical sensing
AI-integrated MEMS sensors for autonomous systems
BioMEMS: Microfluidic sensing for health diagnostics

Module 4: Bulk, Surface, and Advanced Micromachining (7L)
Bulk Micromachining: Anisotropic/directional wet etching, DRIE with Bosch and cryo techniques, Surface Micromachining: High-aspect-ratio fabrication, Anti-stiction strategies using self-assembled monolayers (SAMs)
Nanoimprint Lithography for sub-100nm patterning
Laser micromachining and femtosecond laser ablation
MEMS Packaging: Wafer-level, vacuum-sealed, biocompatible packaging, Role of commercial foundries and MEMS-as-a-service (MaaS)

Module 5: Polymers, Flexible MEMS, and Optical Microsystems (7L)

Polymer MEMS: Updated materials: Polyimide, SU-8, PDMS, Parylene, PMMA, Use in stretchable/flexible MEMS for healthcare and wearables
Flexible and Printed MEMS: Introduction to roll-to-roll fabrication, Printed electronics and paper-based MEMS
Optical MEMS (MOEMS): Active optical MEMS: Micromirrors, tunable lenses, optical

switches, Integration with fiber optics, LiDAR, photonic circuitsMicro-opto-electro-mechanical systems (MOEMS) for AR/VRUse of MEMS in quantum sensing and photonic computing

Text book:

1. "FoundationsofMEMS",ChangLiu,PearsonInternationalEdition, 2006.
2. "RFMEMS Theory,DesignandTechnology",GaberielM.Rebiz,JohnWiley&Sons,2003
3. Micro and Smart Systems, G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Wiley India, 2012.
4. Fundamentals of Nano-and Microengineering S. E.Lyshevski, Nano-and Micro-Electromechanical systems, (Vol. 8). CRC press, (2005).

Reference Books:

1. Introduction to nanotechnology, Charles P.Poole, Frank J.Owens, John Wiley & sons, 2003.
2. MEMS and Nanotechnology for gas sensors", Sunipa Roy, Chandan Kr Saha, Taylor & Francis eBooks,2017
3. Microsensors, MEMS and Smart devices", Julian W.Gardner, Vijay K Varadhan, John Wiley & sons,2001.

Course Name: Research Methodology and Intellectual Property Rights
Course Code: HU602
Contact: 1:0:0
Total Contact Hours: 12
Credit: 1

Course Objective(s):
O1: To introduce the fundamentals of research methodology and techniques for identifying research problems.
O2: To provide awareness on literature review and ethical conduct in research.
O3: To develop understanding of intellectual property rights (IPR) and its implications in academia and industry.

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

CO1	Define and formulate a research problem.
CO2	Perform a basic literature review and identify research gaps.
CO3	Demonstrate awareness of ethical practices in research and publication
CO4	Understand the importance of IPR in safeguarding innovations

CO-PO-PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO1 0**	**PO1 1**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	1	-	-	-	-	-	-	2	-	2	2	2
CO2	3	2	2	-	-	-	-	-	-	2	-	2	2	2
CO3	2	-	-	-	-	3	3	2	-	2	-	2	2	2
CO4	2	-	-	-	-	2	3	2	-	2	-	2	2	2

Course Contents:

Module I: Introduction to Research Methodology [2L]

Definition, objectives, and significance of research; types of research; steps in research process; formulating research problem; importance of literature review; primary and secondary sources; identifying research gaps.

Module II: Research Ethics and Integrity [2L]

Research misconduct (Falsification, Fabrication, Plagiarism); conflict of interest; predatory journals; ethical publishing practices; citation practices; tools for plagiarism detection.

Module III: Basics of Report Writing [2L]

Structure of a research report; academic referencing; bibliography; abstracting and summarizing techniques.

Module IV: Intellectual Property Rights [6L]

Introduction to IPR: patents, copyrights, trademarks, GI. Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Legal requirements for patents — Granting of patent. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Patent document: specification and Claims. Govt. Schemes of IPR

Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks.

Copyrights Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law. Originality of material, rights of reproduction, rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration.

Geographical Indication of Goods, GI Protection.

Textbooks:

1. C. R. Kothari – Research Methodology: Methods and Techniques, New Age International.
2. Catherine J. Holland – Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets, Entrepreneur Press, 2007.

Reference Books:

1. The Institute of Company Secretaries of India – Professional Programme: Intellectual Property Rights, Law and Practice, Sept 2013.
2. Miro Todorovich, Paul Kurtz, Sidney Hook – The Ethics of Teaching and Scientific Research.

Course Name: Computer Network Lab
Course Code: ECS691
Contact: 0:0:3
Credit: 1.5

Prerequisites: Introduction to computer networks and the technical foundations of the Internet, including applications, protocols, local area networks, algorithms for routing and congestion control, security, elementary performance evaluation

Course Objective(s):

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

O1: Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
O2: Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
O3: Understand the concepts of Congestion control and building the skills of sub-netting and routing mechanisms.
O4: Acquire knowledge of Application layer paradigms and protocols.

Course Outcomes (COs):

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

CO1	Understand and explain the concept of Data Communication and networks, layered architecture and their applications.
CO2	Evaluate data communication link considering elementary concepts of datalink layer protocols for error detection and correction.
CO3	UnderstandtheconceptsofCongestioncontrolandbuildingtheskillsofsubnetting and routing mechanisms.
CO4	Acquire knowledge of Application layer paradigms and protocols.

CO-PO Mapping:

CO	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	1	-	2	-	-	-	-	2	1	2	3	3
CO2	3	3	1	-	2	-	-	-	-	2	1	2	2	2
CO3	3	3	2	-	2	-	-	-	-	2	2	2	2	2
CO4	3	1	1	-	2	-	-	-	-	2	1	2	2	2

List of Experiments

1. Implementation IPC using Message queue
2. NIC Installation & Configuration (Windows/Linux)
3. Familiarization withNetworking cables (CAT5, UTP)
4. Familiarization with Connectors (RJ45, T-connector)
5. Familiarization with Hubs, Switches
4. TCP/UDP Socket Programming Simple, TCP based, UDP based,
5. TCP/UDP Socket Programming Multicast & Broadcast Sockets
6. TCP/UDP Socket Programming Implementation of a Prototype Multithreaded Server

7. Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
8. Implementation of Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
9. Examining WAN Connections
10. Connecting a Switch

List of experiments (Beyond syllabus)

1. Observing Static and Dynamic Routing
2. Configuring Ethernet and Serial Interfaces

Text book:

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

Reference Books:

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

Course Name: Machine Learning Lab
Course Code: ECS692
Contact: 0:0:3
Credit: 1.5

Course Objective(s):

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

1. O1: Comprehend the concept of supervised and unsupervised learning techniques
2. O2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. O3. Analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Course Outcomes (COs):

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

CO1	Understand the concepts of various machine learning strategies.
CO2	Handle computational data and learn ANN learning models.
CO3	Apply appropriate data sets to the Machine Learning algorithms
CO4	Identify and apply Machine Learning algorithms to solve real world problems

CO-PO Mapping:

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

List of Experiments:

1. Implement Decision Tree learning
2. Implement Logistic Regression
3. Implement classification using Multilayer Perceptron
4. Implement classification using SVM
5. Implement K-mode clustering
6. Implement k-nearest neighbor algorithm.
7. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
8. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.

9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Beyond Syllabus:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.

Text book:

1. Shai Shalev-Shwartzand Shai Ben- David, "Understanding Machine Learning, Cambridge University Press.
2. Christopher M. Bishop, "Pattern recognition and machine learning", Springer.
3. Richard O Duda, Peter E. Hart & David G. Stock , "Pattern Classification", John Wiley.
4. S.Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy logic and Genetic Algorithm:Synthesys and Applications, Pearson Education.
5. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Pearson, Third Edition, 2014.

Reference book:

1. Konstantinos Koutroumbas, Sergios Theodoridis,, "Pattern Recognition", Elsevier.
2. Simon Haykin, Neural Networks- A Comprehensive Foundation, Prentice Hall.
3. B.Yegnanarayana, Artificial Neural Networks, PHI.
4. Friedman Jerome, Trevor Hastie, and Robert Tibshirani. The Elements of Statistical Learning. Springer-Verlag, 2nd Edition, 2013.
5. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Course Name: Control System Engineering Lab
Course Code: ECS693A
Contact: 0:0:3
Credit:1.5
Prerequisites:
Knowledge of MATLAB & basic linear algebra.

Course Objective(s):

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

1. O1: Understand and working knowledge of design, implementation and analysis Control systems.
2. O2: Determine time response of given control system model.
3. O2: Implement of root locus, Bode-plot, Nyquist Plot using MATLAB control system toolbox.

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

CO1	Familiarize with MATLAB Control System tool Box, MATLAB-SIMULINK tool box.
CO2	Determine step response for 1st order & 2nd order system with a unity feedback
CO3	Simulate step response & impulse response for Type-I & Type-II system with unity feedback using MATLAB.
CO4	Determine root locus, Bode-plot, Nyquist Plot, using MATLAB control system toolbox for a given 2nd order transfer function
CO5	Determine different control system specifications and also approximate transfer function experimentally using Bode Plot.

CO-PO Mapping:

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

LIST OF EXPERIMENTS:

1. Familiarization with MATLAB control system toolbox and representation of pole zero and transfer function of control system.
2. Determination of transfer functions of a given system from its state model and its vice-versa.
3. Determination of impulse, ramp & step response for 2nd order under damped system in MATLAB & calculation of control system specifications for variation of system design.

4. Determination of impulse, ramp & step response for 1st order under damped system in MATLAB & calculation of control system specifications for variation of system design.
5. Determination of Root Locus from transfer function and evaluation of system parameters like marginal value of gain, frequency etc. of a given control system.
6. Drawing of Nyquist plot from transfer function of a control system and estimation of relative system parameters like gain margin, phase margin etc.
7. Drawing of Bode plot from transfer function of a control system and estimation of relative system parameters like gain margin, phase margin etc.
8. Determination of a transfer functions from the state model.
9. Determination of eigen value, eigen vector & diagonal matrix from the state model.
10. Determination of controllability & observability from the state model.

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. Simulate the output response of P. PI, PD & PID controller in MATLAB.

Text book:

1. B. C. Kuo , "Automatic Control Systems", 8th edition, 2003– John Wiley and son's.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 2nd edition.
3. Norman S. Nise, "Control Systems Engineering", John Wiley and son's.
4. Ramesh Babu , "Control System Engineering", Scitech.

Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd, edition, 1998.
2. Richard C. Dorf , "Modern Control Systems", Global Edition.
3. N.K.Sinha, "Control Systems" New Age International (P) Limited Publishers, 3rdEdition, 1998.
4. Narciso F. Macia George J. Thaler, "Modeling& Control of Dynamic Systems" Thomson Publishers.

Course Name: Digital Image Processing Laboratory
Course Code: ECS693B
Contact: (L:T:P) 0:0:3
Credit: 1.5
Prerequisites:

A solid foundation in mathematics, particularly linear algebra, calculus, and probability & statistics, is essential for digital image processing. Basic programming skills (especially in languages like Python, MATLAB, or C++) and familiarity with digital electronics are also crucial.

Course Objective(s):

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

O1: To study the image fundamentals and mathematical transforms necessary for image processing.
O2: To study the image enhancement techniques
O3: To study image restoration procedures.
O4: To study the image compression procedures.

COURSE OUTCOMES:

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

CO1	Study the image fundamentals, mathematical transforms necessary for image processing
CO2	About the various techniques of image enhancement, reconstruction, compression and segmentation.
CO3	Know sampling and reconstruction procedures
CO4	Design image processing systems

CO-PO Mapping:

CO	**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**
CO 1	3	3	1	1	1	1	1	1	1	-	2	2	3	3
CO 2	3	3	1	1	1	1	1	1	1	-	2	2	3	2
CO 3	3	3	1	2	1	1	1	1	1	-	2	2	3	2
CO 4	3	3	3	3	1	1	1	1	1	-	2	2	3	2

LIST OF EXPERIMENTS:

1. Display of Gray scale Images
2. Histogram Equalization
3. Design of Non-linear Filtering
4. Determination of Edge detection using Operators
5. 2-Dimensional Discrete Fourier Transformation and Discrete Cosine Transformation
6. Filtering in frequency domain
7. Display of color images
8. Conversion between color spaces.
9. Discrete Wavelet Transformation of images.
10. Segmentation using watershed transform

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. Real-Time Object Detection in Images/Videos
(Use techniques like YOLO (You Only Look Once) or SSD (Single Shot Detector) for real-time object detection in images or videos)
2. Image Style Transfer Using Deep Learning
(Implement image style transfer using convolutional neural networks (CNNs) to blend the content of one image with the style of another)

TEXT BOOKS:

1. Digital Image Processing, Rafael C. Gonzales, Richard E. Woods, Pearson Education, 3rd Edition, 2010.
2. Fundamentals of Digital Image Processing, S. Annadurai, R. Shanmugalakshmi, Pearson Education, 2nd Edition, 2006
3. Fundamental of Digital Image Processing, Anil K Jain, Prentice Hall, 1st Edition, 1989
4. The essential guide to image processing, A C. Bovik, Academic Press, 2nd Edition, 2009
5. Digital Video Processing, M. Teckalp, Prentice Hall PTR, Special Edition, 1995

REFERENCEBOOKS:

1. Digital Image Processing, Willliam K Pratt, John Willey, 2nd Edition, 2002.
2. Digital Image Processing and Pattern Recognition Malay K. Pakhira, PHI Learning Pvt. Ltd., First Edition, 2011.
3. Fundamentals of Digital Image Processing, A.K.Jain, Prentice Hall India, Special Edition, 2017.
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Tata Mc Graw Hill Pvt. Ltd., 3rd Edition, 2011.
5. Fundamentals of Digital Image Processing, Anil Jain K., PHI Learning Pvt. Ltd., 1st Edition, 2011.
6. Digital Image Processing Madhuri.A.Joshi, Prentice Hall India, 1st Edition, 2013
7. Analysis of Image Processing and Machine Vision, Sonka, Spec Cengage Publications, 1st Edition, 2008.

Course Name: Information Theory & Coding Lab
Course Code: ECS693C
Contact: 0:0:3
Credit: 1.5

Prerequisites:

Knowledge of MATLAB & basic linear algebra.

Course Objective(s):

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

1. O1: Introduce concepts of information theory and various source coding techniques.
2. O2: Calculate channel capacity and rate of information in the digital communication system.
3. O3: Apply source coding techniques to compress and encrypt data.
4. O4: Implement various error detection and correction coding techniques in the communication system to solve problems.

Course Outcomes (COs):

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

CO1	Understand the concepts of information theory and various source coding techniques.
CO2	Calculate channel capacity and rate of information in the digital communication system.
CO3	Apply source coding techniques to compress and encrypt data.
CO4	Implement various error detection and correction coding techniques in the communication system to solve problems.
CO5	Design circuits for different error control coding techniques.

CO-PO Mapping:

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

LIST OF EXPERIMENTS:

1. Write a program for determination of various entropies and mutual information of a given Noise free channel.
2. Write a program for Testing various types of channel such as Error free channel, Binary symmetric channel & Noisy channel Compare channel capacity of above channels.
3. Implement a program for generation of variable length source coding using Huffman Coding and decoding (MATLAB).

4. Implement coding and decoding of Cyclic codes.

5. Implement coding and decoding of Linear block codes.
6. Implement coding and decoding of BCH and RS codes.
7. Implement coding and decoding of Convolutional codes.
8. Implement a program to study performance of a coded communication system (Calculate the error probability).
9. Implement a program for evaluation of variable length source coding using Huffman Coding and decoding (MATLAB).

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. Implement a program to study performance of an un-coded communication system (Calculate the error probability).

Text book:

1. Ranjan Bose, "Information theory, coding and cryptography", TMH.
2. Salvatore Gravano, "Introduction to Error Control Codes", Oxford
3. A Saha, S Mondal, "Information theory, coding and cryptography", Pearson.
4. Todd K Moon,- Error Correction Coding: Mathematical Methods and Algorithms, John Wiley & Sons

Reference Books:

1. N Abramson;, "Information and Coding", McGraw Hill.
2. M Mansurpur , "Introduction to Information Theory", McGraw Hill.
3. R B Ash, "Information Theory", Prentice Hall.
4. Shu Lin and D J Costello Jr; , "Error Control Coding", Prentice Hall.

Course Name: Ad-Hoc and Sensor Networks Lab
Course Code:ECS693D
Contact: 0:0:3
Credit: 1.5

Prerequisites:
The students should have the basic knowledge of communication and networks lab.

Course Objective(s):

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

O1: Give a summary of sensor networks, new technologies, sensor node network architecture, and the environment in which they operate.
O2: To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN
O3: To get knowledge about temporal synchronization for localization services using sensor tasking and control, as well as topology control and clustering in networks
2O4: To study about sensor node using LEACH and SPIN protocols of WSNs.

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

CO1	Simulate different topologies of Ad-hoc networks
CO2	Implement the physical and MAC layer protocols of Ad-hoc networks.
CO3	Apply TCP and UDP protocols for Ad-hoc networks.
CO4	Implement the LEACH and SPIN protocols of WSNs

CO-PO Mapping:

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

LIST OF EXPERIMENTS:
Note: Implement Experiment No: 1 to 5 using NS2/NS3 Simulation Tool. Implement Experiment No: 6 to 8 using MATLAB Tool.
1. Create a sample wireless topology using Simulation Tool.
2. Create a mobile Ad-hoc networks using Simulation Tool.
3. Implement an Ad-hoc On-demand Distance Vector protocol using Simulation Tool.
4. Implement a Transmission Control Protocol using Simulation Tool.
5. Implement a User Datagram Protocol using Simulation Tool.
6. Implement a Low Energy Adaptive Hierarchy protocol using Simulation Tool.
7. Implement a Power Efficient Gathering in Sensor Information System using Simulation Tool.

8. Implement a Sensor Protocol for Information via Negotiation (SPIN) using Simulation Tool.
9. Implement a Power Efficient and Delay Aware MAC protocol using Simulation Tool.
10. Implement a Predictive Wake-up MAC protocol using Simulation Tool.

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. Implement a Proactive and Reactive based MAC protocol using Simulation Tool.
2. Implement a Scheduling based protocol for WSNs using Simulation Tool.

Text book:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An 16 PG Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
3. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

Course Name: Data Mining Lab
Course Code: ECS694A
Contact: 0:0:3
Credit: 1.5

Prerequisites:

Knowledge of MATLAB & basic linear algebra.

Course Objective(s):

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

O1: To teach principles, concepts and applications of data warehousing and data mining
O2: To introduce the task of data mining as an important phase of knowledge recovery process
O3: To inculcate fundamental concepts that provides the foundation of data mining

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

CO1	Design a data mart for any organization
CO2	Extract knowledge using data mining techniques
CO3	Adapt to new data mining tools.
CO4	Explore recent trends in data mining such as web mining, spatial-temporal mining

CO-PO Mapping:

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

LIST OF EXPERIMENTS:

1. Generate Association Rules using the Apriori algorithm.
2. Generate Association Rules using the FP-Growth algorithm.
3. Demonstrate classification process on a given dataset using Naïve Bayesian Classifier.
4. Demonstrate classification process on a given dataset using nearest neighbor Classifier.
5. Build a distance matrix of the given data using various distance measures.
6. Cluster the given dataset by using the k-Means algorithm and visualize the cluster mean values and standard deviation of dataset attributes.
7. Demonstrate classification process on a given dataset using Rule based Classifier.
8. Build a distance matrix of the given data using various distance measures.
9. Pre-process a given dataset based on the following: a. Attribute Selection b. Handling Missing

Values.

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. Build a Decision Tree using ID3 algorithm

Text book:

1. Pang-NingTan,MichaelSteinbach, VipinKumar, IntroductiontoDataMining, 2nd edition, Pearson education, 2018.
2. Jlawei Han & Micheline Kamber, Data Mining, "Concepts and Techniques", 3rd edition, Morgan Kaufmann Publishers, 2012.
3. Margaret H Dunham, Data Mining Introductory and advanced topics, 6th edition, Pearson Education, 2009

Reference book:

1. Robert Layton, "Learning Data Mining with Python", Packet Publishing

Course Name: Design and Simulation lab
Course Code: ECS694B
Contact: 0:0:3
Credit: 1.5

Prerequisites:

Students should have a foundational understanding of the following subjects and skills:Basic Electronics, Digital Logic Design, Electronic Devices and Circuits, Signals and Systems, Communication Systems (Basics), Programming and Software Tools (Basic Proficiency).

Course Objective(s):

O1: To understand the behavior of analog, digital, and mixed-signal circuits through simulation.

1. O2: To design and simulate communication systems and analyze performance.
2. O3: To use EDA tools like MATLAB, Simulink, Multisim, LTspice, Cadence, or Tanner for system-level simulation and verification.

Course Outcomes (COs):

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

CO1	Understand the fundamentals of analog and digital circuit simulation using EDA tools
CO2	Design and simulate combinational and sequential digital circuits
CO3	Model and simulate analog circuits (e.g., filters, amplifiers, oscillators) and interpret performance metrics
CO4	Simulate communication systems using MATLAB/Simulink and analyze modulation and channel performance
CO5	Apply system modeling techniques using tools like Simulink for physical and queuing systems
CO6	Use modern EDA tools (e.g., Tanner, Cadence) for CMOS design and layout simulation

CO-PO Mapping:

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

LIST OF EXPERIMENTS:

1. Simulation of basic gates (AND, OR, NOT, NAND, NOR, XOR) using CMOS/TTL logic
2. Design and simulation of combinational circuits: Full Adder / 4:1 MUX
3. Design and simulation of flip-flops (D, T) and 3-bit counters
4. Transient and DC analysis of CMOS inverter and logic gates
5. Simulation of Op-Amp circuits: Inverting and Non-Inverting Amplifiers

6. Design and simulation of RC Low-pass and High-pass filters
7. Simulation of AM and FM modulation and demodulation
8. Simulation of digital modulation techniques: BPSK, QPSK
9. Modeling of dynamic systems: Mass-Spring-Damper using Simulink
10. Random number generation and histogram analysis using MATLAB

LIST OF EXPERIMENTS (BEYOND SYLLABUS):

1. CMOS schematic design and simulation using Tanner or Cadence
2. Transient and power analysis of a combinational circuit

Text Books

1. "Discrete-Event System Simulation" by Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, Pearson Education, 5th Edition, 2010.
2. "System Simulation with Digital Computer" by Narsingh Deo, Prentice-Hall of India (PHI Learning Pvt. Ltd.), 1st edition, 1979.
3. "System Simulation" by Geoffrey Gordon, Prentice-Hall of India (PHI Learning Pvt. Ltd.), 2nd edition, 1978.
4. "Simulation Modeling and Analysis" by Averill M. Law and W. David Kelton, McGraw-Hill Education, 5th edition, 2014.
5. "Modeling and Simulation of Systems Using MATLAB and Simulink" by Devendra K. Chaturvedi, CRC Press (Taylor & Francis Group), 1st edition, 2017.

Reference Books

1. "Simulation Modelling and Analysis" by Averill Law and W. David Kelton, McGraw-Hill Education, 5th edition, 2014.
2. "Principles of Modeling and Simulation" by John A. Sokolowski & Catherine M. Banks, Wiley (John Wiley & Sons, Inc.)1st edition, 2009.
3. "Introduction to Modeling and Simulation of Technical and Physical Systems with Modelica" by Peter Fritzson, Wiley-IEEE Press1st edition, 2011
4. "Modelling and Simulation" by V. P. Singh, University Science Press (An imprint of Laxmi Publications Pvt. Ltd.)1st edition, 2009.

Course Name: Cloud Computing Laboratory
Course Code: ECS694C
Contact: 0:0:3
Credit: 1.5

Prerequisites:
To effectively engage with a Cloud Computing laboratory, foundational knowledge in several areas is crucial. These include networking, virtualization, operating systems (especially Linux), and database management. Programming skills, particularly in Python, Java, or Bash, are also essential for automating tasks and interacting with cloud services.

Course Objective(s):
The objective of the course is to make the students able to –
O1: To inculcate the concepts of distributed computing
O2: To familiarize the concepts of cloud computing and services
O3: To explain cloud platform and types of cloud IV.
O4: To explain resource management in cloud

COURSE OUTCOMES:

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

CO1	Understand the fundamental principles of distributed computing
CO2	Create virtual machines and virtual templates
CO3	Create Cloud platform using Virtual machines
CO4	Identify suitable business models of cloud computing

CO-PO Mapping:

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

LIST OF EXPERIMENTS

1. Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and executes Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using Cloud-Sim and run a scheduling algorithm that is not present in Cloud-Sim.

6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version)
8. Install Hadoop single node cluster and run simple applications like word count
9. Install a C++ compiler in the virtual machine and execute a sample program.
10. Show the virtual machine migration based on the certain condition from one node to the other.

LIST OF EXPERIMENTS (Beyond Syllabus):

1. Implementing Cloud-Based DevOps with CI/CD(Set up a Continuous Integration/Continuous Deployment (CI/CD) pipeline for a cloud-based application)

2. Deploying a Multi-Cloud Application(Deploy an application across multiple cloud platforms like AWS and Microsoft Azure)

Text Books:

1. Distributed and cloud computing from Parallel Processing to the Internet of Things, Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Morgan Kaufmann Press, Elsevier, 2nd Edition, – 2012
2. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , 1st Edition, New Delhi – 2010
3. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller, Que Publisher, Special Edition, 2008
4. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2nd Edition 2010
5. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski - John Wiley & Sons, Inc. , 1st Edition, 2011

Reference Books:

1. Cloud Computing Bible, Barrie Sosinsky, - John Wiley & Sons, 2nd Edition, 2010
2. Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly Publ, 1st Edition, 2009
3. Cloud Computing Implementation, Management and Security, John Witing-house jamesF.Ransome, CRC Press, Special Edition.
4. Handbook of Cloud Computing, Borko Furht. Armando Escalante, Springer, Special Edition, 2010
5. Cloud Revolution, Charles Badcock, TMH, Special Edition, 2012

Course Name: Optimization Techniques Lab
Course Code: ECS694D
Contact: 0:0:3
Credit: 1.5
Prerequisites:
Knowledge of MATLAB & basic linear algebra.

Course Objective(s):

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

O1: To teach principles, concepts and applications of optimization techniques.
O2: To introduce the task of data mining as an important phase of knowledge recovery process
O3: Frame engineering minima maxima problems in the framework of optimization problems.

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

CO1	Cast engineering minima/maxima problems into optimization framework.
CO2	Learn efficient computational procedures to solve optimization problems.
CO3	Use MATLAB to implement important optimization methods.
CO4	Model engineering minima/maxima problems as optimization problems.

CO-PO Mapping:

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

LIST OF EXPERIMENTS:

1. Matrix operations in MATLAB
2. Differentiation of a vector and matrix in MATLAB
3. Integration of a vector and matrix in MATLAB
4. Applications on queuing, soft computing and fuzzy logic
5. Applications on Markov Chain and hidden Markov models
6. Implementation of Newton's method in MATLAB
7. Implementation of KKT theorem in MATLAB
8. Implementation of BFGS method in MATLAB
9. Implementation of Secant method in MATLAB.

LIST OF EXPERIMENTS (Beyond Syllabus):

1. Implementation of Simplex algorithm in MATLAB

Text book:

1. Edwin P K Chong, Stainslaw Zak , "An introduction to Optimization", Wiley-Interscience Series in Discrete Mathematics and Optimization.
2. Dimitri Bertsekas , "Nonlinear Programming", Athena Scientific, Belmont, Massacheuttes.
3. Niclas Andr´easson, Anton Evgrafov, and Michael Patriksson, "An Introduction to Optimization: Foundations and Fundamental Algorithms".

Reference book:

1. Wu-Sheng Lu, Stanislaw H. Zak, "An Introduction to Optimization: With Applications to Machine Learning", John Wiley and Sons Ltd.

Syllabus of 4th year _R25_ ECS

4th Year 7th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	ECS701	Industrial Automation	3	0	0	3	3
2	ENGG	Major	ECS702A	Quantum Computing	3	0	0	3	3
			ECS702B	Blockchain Technology					
			ECS702C	Big Data Analytics					
			ECS702D	Generative AI					
3	ENGG	Minor	CS(ECS)701A	Real Time System	2	0	0	2	2
			CS(ECS)701B	Cyber Security					
			CS(ECS)701C	Neural Networks and Deep Learning					
			CS(ECS)701D	Soft Computing					
4	HUM	Skill Enhancement Course	HU(EC)701	Project Management and Finance	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	ECS791	Industrial Automation Lab	0	0	3	3	1.5
2	ENGG	Skill Enhancement Course	PR791	Rapid Prototyping Lab	0	0	0	3	1.5
3	PRJ	Project	ECS781	Project-III	0	0	0	12	6
Total of Theory, Practical								28	19

Course Name: Industrial Automation
Course Code: ECS701
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: knowledge of I/O in computer-based systems, knowledge of network

Course Objective(s):

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

O1. To make the learner understand the benefits of using industrial automation systems

O2. To make the learner acquainted with the features of PLC, DCS, and SCADA (basic architectures, networking principles, programming, I/O systems)

O3. To make the learner able to program a PLC

O4. To make the learner able to compare the strengths of PLC, DCS, and SCADA

Course Outcomes (COs):

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

CO1	appreciate the advantages of automated manufacturing systems
CO2	identify the uniqueness of PLC, DCS, and SCADA
CO3	select a suitable PLC or DCS or SCADA system for an automation solution, based on thetype and size of the production facility
CO4	program a PLC for a given automation problem

CO-PO Mapping:

CO	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
CO 1	3	3	2	2	3	2	2	1	1	1	1	2	2	3
CO 2	3	2	2	2	3	1	1	1	1	1	2	3	3	3
CO 3	3	3	3	3	3	1	2	2	2	2	2	2	1	3
CO 4	3	3	3	2	3	1	2	1	2	2	2	1	2	3

Course Content:

Module 1: PLC [8L]

Introduction to Programmable Logic Controllers (PLCs) – Basic Architecture and Functions; Input-Output Modules and Interfacing; CPU and Memory; Relays, Timers, Counters and their uses; Ladder diagram Programming, Scan time; Applications of PLC

Module 2: DCS [12L]

DCS – basic components and their functions. HMI – operator & engineering interface, functions and requirements. Communication – ISO/OSI reference model; data highway and Fieldbus; HARTNetwork access protocols – TDMA, CSMA/CD, token passing, Master– Slave Transmission media – twisted pair, co-axial, optical fiber ; Network topology – mesh, ring, star, bus; Redundancy – processor, bus and input-output level

Module 3: Plant Automation [10L]

Plant Automation System network Elements of Plant Automation System (PAS) : Smart Sensors, Sensor networks, Intelligent actuators, SCADA systems, Introduction, Different Generations, I/OModules (wired and wireless), MTU and RTU, AS-Interface.
Safety Interlocks, Sequence Controls PAS network and typical system architecture

Module 4: Case studies [6L]

Case studies- rolling mill control (system with time delay), pH control (nonlinear system),temperature control and pressure control of a boiler

Text book:

1. Industrial Automation Using PLC, SCADA, and DCS, R. G. Jamkar, Global Education Ltd., 2nd Edition, 2018.
2. PLCs & SCADA – Theory and Practice, R. Mehra and V. Vij, Laxmi Publications Pvt. Ltd., 2nd Edition, 2017.
3. Programmable Logic Controllers: Principles and Applications, John W. Webb and Ronald A. Reis, Pearson Education, 5th Edition, 2003.
4. Programmable Logic Controllers: An Introduction, Frank D. Petruzella, McGraw-Hill Education, 5th Edition, 2016.

Reference Books:

1. 1. Modern Distributed Control Systems, M. Elshafei, CreateSpace (Amazon Digital Services), 1st Edition, 2016.
2. Instrument Engineers' Handbook (Vol. 2: Process Control and Optimization), B. G. Lipták (Ed.), CRC Press, 4th Edition, 2005.
3. Process Control: Modeling, Design, and Simulation, B. Wayne Bequette, Prentice Hall, 1st Edition, 2003.

Course Name: Quantum Computing
Course Code: ECS702A
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Discrete Structures

Course Objective(s):

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

O1. Understand quantum mechanics concepts relevant to computing.

O2. Learn and analyze basic quantum algorithms.

O3. Explore quantum hardware and error correction.

O4. Apply quantum computing tools to real-world problems.

Course Outcomes (COs):

After Successful 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 forsolving 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.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to Quantum Computation: 8L

Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

Module 2: Quantum Circuits: 6L

Single qubit gates, multiple qubit gates, design of quantum circuits

Module 3: Quantum Information and Cryptography: 6L

Comparison between classical and quantum information theory. Bell states. Quantum teleportation Quantum Cryptography, no cloning theorem.

Module 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.

Module 5: Noise and error correction: 8L
Graph states and codes, Quantum error correction, fault-tolerant computation.

Text Books:

1. Quantum Computation and Quantum Information, M. A. Nielsen and I. L. Chuang, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Principles of Quantum Computation and Information, G. Benenti, G. Casati and G. Strini, Vol. I: Basic Concepts; Vol. II: Basic Tools and Special Topics, World Scientific, 1st Edition, 2004.
3. An Introduction to Quantum Computing Algorithms, A. O. Pittenger, Springer, 1st Edition, 1999.
4. Quantum Computing from the Ground Up, R. T. Perry, World Scientific Publishing, 1st Edition, 2012.

Reference Books:

1. An Introduction to Quantum Computing, P. Kaye, R. Laflamme and M. Mosca, Oxford University Press, 1st Edition, 2007.
2. Quantum Computing: A Gentle Introduction, E. G. Rieffel and W. H. Polak, MIT Press, 1st Edition, 2011.
3. Quantum Computing for Computer Scientists, N. S. Yanofsky and M. A. Mannucci, Cambridge University Press, 1st Edition, 2008.
4. Quantum Computing Since Democritus, S. Aaronson, Cambridge University Press, 1st Edition, 2013.
5. Introduction to Optical Quantum Information Processing, P. Kok and B. W. Lovett, Cambridge University Press, 1st Edition, 2010.

Course Name: Blockchain Technology
Course Code: ECS702B
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: The students must have concept of Distributed Systems, Computer Networks, Cryptography, Python Programming Language.

Course Objective(s):

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

O1 . Understand the fundamentals of blockchain architecture, consensus mechanisms, and cryptography.
O2 . Learn smart contract development and decentralized application (DApp) design.
O3 . Explore blockchain platforms, frameworks, and their real-world use cases.
O4 . Apply blockchain concepts to solve practical problems in various industries.

Course Outcomes (COs):

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

CO1	Understand the basic concepts of blockchain and it's architectures.
CO2	Analyze different issues in the domain of blockchain and understand the practical applications of blockchain
CO3	Evaluate and analyze different solutions for the real-life problems related to the blockchain
CO4	Design different solution applying and analyzing concept of Block chain

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	2	-	-	-	-	-	2	2	3	2
CO2	2	3	2	-	2	2	-	-	-	-	2	2	3	3
CO3	2	3	3	2	2	2	-	-	-	-	3	2	2	3
CO4	2	2	3	2	3	2	-	2	2	2	3	3	2	-

Course Content:

Module 1: Centralized Distributed Systems: [6L]

Client-Server Model, Distributed System, P2P Network Model, Distributed Database, Two General Problem in distributed database, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.

Module 2: Security, Trust and Privacy: [6L]
Confidentiality; Integrity; Availability; Authentication; Authorization; Access Control; Accounting; Non-Repudiation, Symmetric Key and Asymmetric Key Cryptography, Hash function, Merkle tree hash, Digital Signatures – RSA, Schnorr, and ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, User privacy.

Module 3: Fundamentals of Blockchain: [6L]
Introduction, Benefits over traditional distributed database, Blockchain Network, Data structure of block, Block construction and addition, Block mining mechanisms, Merkle Pa-tricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain policy, Real-time application of Blockchain, Soft & Hard Fork, Private, Public, and Consortium blockchain.

Module 4: Consensus algorithms in Blockchain: [9L]
Distributed Consensus, Nakamoto consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB), Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Difficulty Level, Sybil Attack, Energy utilization and alternate.

Module 5: Cryptocurrency and Blockchain Applications: [9L]
History, Distributed Ledger Technology (DLT),Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contracts and Distributed Applications (Apps), GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Application of Blockchain in Finance and Banking, Energy trading, Internet of Things (IoV, IoD, IIoT, Smart city, Smart Home, and so on), Medical Record Management System, Real estate business, Entertainment, Future scope of Blockchain.

Text Books:

1. Distributed Ledger Technology: The Science of the Blockchain, Roger Wattenhofer, CreateSpace Independent Publishing, 2nd Edition, 2017.
2. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Princeton University Press, 1st Edition, 2016.
3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, 1st Edition, 2014.
4. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, 1st Edition, 2017.

Reference Books:

1. Blockchain: Blueprint for a New Economy, Melanie Swan, O'Reilly Media, 1st Edition, 2015.
2. Mastering Ethereum: Building Smart Contracts and DApps, Andreas M. Antonopoulos and Dr. Gavin Wood, O'Reilly Media, 1st Edition, 2018.
3. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World, Don Tapscott and Alex Tapscott, Penguin Random House, 1st Edition, 2016.

Course Name: Big Data Analytics
Course Code: ECS702C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python

Course Objective(s):

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

O1. Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).

O2. Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions

O3. Apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.

O4. Excogitate and Implement ideas to address the challenging issues of Big Data Analytics.

O5. Analyze the effectiveness of various Big Data Analytics Frameworks.

Course Outcomes (COs):

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

CO1	Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework) underscoring the utilitarian importance incurrent technological context for further exploration leading towards lifelong learning.
CO2	Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks
CO3	Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce, Hadoop and advanced SQL Frameworks.
CO4	Excogitated as for proposing solutions to the challenging problems of Big Data Analytics.
CO5	Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the

	performances using proper techniques.

CO-PO Mapping:

CO	PO 1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	3	3	2	-	-	-	-	1	1	-
CO 2	2	3	1	1	1	1	1	-	-	-	-	1	1	-
CO 3	2	2	3	2	1	1	1	-	-	-	-	1	1	-
CO 4	2	2	2	3	1	1	1	-	-	-	-	2	2	-
CO 5	2	2	3	3	2	2	2	-	-	-	-	2	1	1

Course Content:

Module 1: Introduction to Basic Analytics [10L]

Introduction: Big data overview, Analyst's perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics.

Life Cycle of Data Analytics: Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational.

Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module 2: Advanced Analytic Methods I [8L]

Clustering: Overview, K-means, Determining the number of clusters, Diagnostics. Association Rules: Overview, A priori algorithm, Evaluation of candidate rules, Application ofassociation rules, Validation and testing, Diagnostics.

Regression: Linear regression - model description, Logistic regression – model description, Other regression models.

Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, , Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of Classifier

Module 3: Advanced Analytic Methods II [8L]

Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model.

Text Analysis: Steps in text analysis, collecting raw text, representing text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments. Map Reduce and Hadoop: Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module 4: Advanced Analytic Methods III [10L]

Technology and Tools: SQL essentials - Join, Set, grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL.

Integration of Techniques: Communicating and operationalizing an analytic project.

Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code.

Data visualization basics - Key points, evolution of a graph, common representation methods, how toclean up a graphic.

Text Books

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services (Editor), Wiley, 1st Edition, 2015
2. Real-Time Big Data Analytics: Emerging Architecture, Mike Barlow, O'Reilly Media, 1st Edition, 2013
3. Big Data and Analytics, Seema Acharya and Subhasini Chellappan, Wiley India Pvt. Ltd., 2nd Edition, 2019.
4. Big Data: Principles and Best Practices of Scalable Realtime Data Systems, Nathan Marz and James Warren, Manning Publications, 1st Edition, 2015.

Reference Books

1. Big Data: Principles and Best Practices for Scalable Real-Time Data Systems**,** Nathan Marz and James Warren, Manning Publications**,** 1st Edition, 2015
2. Big Data Analytics**,** Venkat Ankam, Packt Publishing**,** 1st Edition, 2016
3. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, and Jeffrey D. Ullman, Cambridge University Press, 3rd Edition, 2020.

Course Name: Generative Artificial Intelligence
Course Code: ECS702D
Contact: 3:0:0
Total Contact Hours: 36
Credit:3

Prerequisites:
Introduction to Artificial Intelligence
Basics of Machine Learning

Course Objective(s):
The objective of the course is to make the students able to –
O1. Understand the fundamental concepts, architectures, and applications of Generative AI.
O2. Analyze and compare different generative models and their use-cases.
O3. Design and implement basic generative models for data synthesis and creative tasks.
O4. Evaluate the effectiveness and limitations of generative models in real-world scenarios.
O5. Discuss the ethical, societal, and security implications of Generative AI.

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

CO1	Explain the core principles, architectures, and evolution of Generative AI.
CO2	Identify and formulate problems suitable for generative modeling in various domains.
CO3	Apply and compare different generative models (e.g., GANs, VAEs, LLMs) for data generation tasks.
CO4	Develop and implement basic generative models using standard AI frameworks.
CO5	Analyze the impact, limitations, and ethical considerations of Generative AI in society and industry.

CO-PO Mapping:

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

Course Content:

Module 1: Introduction to Generative AI (6 Lectures)
What is Generative AI. Evolution and history of generative models, Generative vs Discriminative models, Applications: Text, Image, Audio, Video, Code, Design; Overview of creativity and synthesis in AI

Module 2: Foundations of Generative Models (8 Lectures)
Probability and data distributions, Latent variable models, Autoencoders: Basic concepts and applications, Variational Autoencoders (VAEs): Theory and use-cases, Introduction to Generative Adversarial Networks (GANs): Architecture, training, and challenges, Comparison: VAEs vs GANs

Module 3: Large Language Models and Diffusion Models (8 Lectures)
Introduction to Large Language Models (LLMs): GPT, BERT, T5; Text generation and prompt engineering; Introduction to Diffusion Models: Concepts and applications in image and audio generation; Comparison with other generative models; Hands-on: Using pre-trained generative models (demo/assignment)

Module 4: Applications of Generative AI (7 Lectures)
Text generation: Chatbots, summarization, translation; Image generation: Art, design, deepfakes; Audio and music synthesis; Data augmentation and synthetic data; Generative AI in industry: Healthcare, entertainment, education, cybersecurity; Human-AI collaboration in creative tasks

Module 5: Ethics, Security, and Future of Generative AI (7 Lectures)
Deepfakes and misinformation; Bias, fairness, and responsible AI; Copyright, ownership, and creative rights; Security risks: Adversarial attacks, misuse; Societal impact and regulatory perspectives; Career opportunities and research trends in Generative AI

Text Books:

1. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, David Foster, O'Reilly Media, 2nd Edition, 2023
2. Deep Learning, Ian Goodfellow, Yoshua Bengio & Aaron Courville, MIT Press, 1st Edition, 2016
3. Hands-On Generative AI with Python, John Smith, Packt Publishing, 1st Edition,
4. Mastering Generative AI, Uma N. Chandrasekaran, Packt Publishing, 1st Edition, 2023.

Reference Books:

1. GANs in Action: Deep Learning with Generative Adversarial Networks, Jakub Langr & Vladimir Bok, Manning Publications, 1st Edition,
2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra & Thomas Wolf, O'Reilly Media, 1st Edition,
3. Diffusion Models for Machine Learning, Lilian Weng, 1st Edition

Course Name: Real Time System
Course Code:CS(ECS)701A
Contact: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisites:

1.Concepts of Operating systems and Algorithm.
2.Knowledge of Distributed System basics.

Course Objective(s):

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

O1. To understand the real-time systems

O2. Obtain a broad understanding of the technologies and applications for emerging and exciting domain of real-time systems

O3. Get in-depth hands-on experience in designing and developing a real time system.

Course Outcomes (COs):

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

CO1	Understand the concepts of Real-Time systems
CO2	Recognize the characteristics of a real-time system
CO3	Understand and develop document on an architectural design of a real-time system.
CO4	Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**2**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**			
CO2	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**			
CO3	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**			
CO4	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**			

Course Content:

Module 1: Module-1: Introduction.[6L]

Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc., Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency

Module 2: Module-2: Real Time Scheduling.[6L]

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling

Module 3: Module-3: Resources Sharing.[5L]

Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre- emption Ceiling Protocol, Access control in Multiple Module Resources, Controlling Concurrent Accesses to Data Objects

Module 4: Real Time Communication. .[4L]

Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Modelof Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols

Module 5: Real Time Operating Systems and Databases.[3L]

Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

Text Book:

1. Real-Time Systems, Jane W. S. Liu, Pearson Education, 2nd Edition, 2006
2. Real-Time Systems Design and Analysis: Tools for the Practitioner**,** Phillip A. Laplante, Wiley-IEEE Press, 4th Edition, 2014**.**
3. Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications**,** Giorgio C. Buttazzo, Springer, 2nd Edition, 2011**.**
4. Real-Time Concepts for Embedded Systems, Qing Li and Caroline Yao, CRC Press, 1st Edition, 2003

Reference Books:

1. Real-Time Systems, Rajiv Mall, Pearson Education, 1st Edition, 2008
2. Real-Time Systems: Scheduling, Analysis, and Verification, Albert M. K. Cheng, Wiley, 1st Edition, 2002
3. Real-Time Systems: Scheduling, Analysis, and Verification, Albert M. K. Cheng, Wiley, 1st Edition, 2002.

Course Name: Cyber Security
Course Code: CS(ECS)701B
Contact: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisites:

1.Knowledge of Computer Networks and Operating Systems fundamentals
2,Understanding of Discreet Mathematics concepts

Course Objective(s):

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

O1.To understand basics of Cyber Security & Cryptography.
O2.To be able to secure a message over insecure channel by various means.
O3.To learn about how to maintain the Confidentiality, Integrity and Availability of a data
O4.To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes (COs):

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

CO1	Understand cryptography and network security concepts and application.
CO2	Apply security principles to system design.
CO3	Identify and investigate network security threat
CO4	Analyze and design network security protocols.
CO5	Conduct research in network security.

CO-PO Mapping:

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

Course Content:

Module 1: [7L]
Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security model
Classical Encryption techniques (Symmetric cipher model, substitution techniques, Transpositions techniques, steganography)
Finite Fields and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem
Testing for primality -The Chinese remainder theorem - Discrete logarithms

Module 2: [9L]**)**
Data Encryption Standard- Block cipher principles, block cipher modes of operation
Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm Public key cryptography: Principles of public key cryptosystems, The RSA algorithm Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography

Module 3: [6L]
Authentication requirement, Authentication function, MAC, Hash function
Security of hash function and MAC, MD5, SHA, HMAC, CMAC
Digital signature and authentication protocols, DSS, ElGamal, Schnorr

Module 4: [7L]
Authentication applications, Kerberos, X.509
Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles
SET for E-Commerce Transactions
Intruder, Intrusion detection system
Virus and related threats, Countermeasures
Trusted systems, Practical implementation of cryptography and security

Module 5: [7L]
E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source
Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME
IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP)
Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding) Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction

Text Books:

1. Cryptography and Network Security**,** A. Kahate, Tata McGraw-Hill Education**,** 3rd Edition, 2013.
2. Cryptography and Network Security, Behrouz A. Forouzan & Debdeep Mukhopadhyay, McGraw Hill Education (India) Private Limited, 2nd Edition, 2015.

3. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson Education, 8th Edition, 2023
4. Cybersecurity and Cyberwar: What Everyone Needs to Know, P. W. Singer and Allan Friedman, Oxford University Press, 1st Edition, 2014.

Reference Books:

1. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson Education India, 4th Edition, 2006.
2. Computation, Cryptography, and Network Security, Nikolaos J. Daras & Michael T. Rassias (Eds.), Springer, 1st Edition, 2015.
3. Cryptography and Network Security, Atul Kumar & S. Bose, Pearson Education India, 1st Edition, 2017.

Course Name: Neural Network and Deep Learning
Course Code: CS(ECS)701C
Contact: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisites:
Mathematics. Having a good mathematical background, at least an undergraduate level will prove to be beyond helpful in grasping the neural network technology. A good amount of knowledge in Calculus, LinearAlgebra, Statistics and Probability will smoothen the process of learning the surface of the subject.

Course Objective(s):

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

O1. Understand the fundamentals of artificial neural networks and deep learning architectures.

O2. Apply training algorithms and optimization techniques for neural network models.

O3. Design and implement deep learning solutions for real-world problems.

O4. Evaluate model performance using appropriate metrics and validation methods.

O5. Explore advanced topics such as CNNs, RNNs, GANs, and transfer learning.

Course Outcomes (COs):

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

CO1	understand the concepts of Neural Networks
CO2	select the Learning Networks in modeling real world systems
CO3	use an efficient algorithm for Deep Models
CO4	apply optimization strategies for large scale application

CO-PO Mapping:

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

Course Content:

Module 1: [6L]

Artificial Neural Networks Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Module 2: [7L]

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance TheoryNetworks. Special Networks-Introduction to various networks.

Module 3: [7L]

Introduction to Deep Learning, Historical Trends in Deep learning, Deep Feed - forward networks, Gradient-Basedlearning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms

Module 4: [8L]

Regularization for Deep Learning: Parameter norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised learning, Multi-task learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, tangent Prop and Manifold,Tangent Classifier

Module 5: [8L]

Optimization for Train Deep Models: Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second Order Methods, Optimization Strategies and Meta-Algorithms Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, NaturalLanguage Processing

Text Books:

1. Deep Learning – Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 1st Edition, 2016.
2. Neural Networks and Learning Machines – Simon Haykin, Pearson Prentice Hall, 3rd Edition, 2009.
3. Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer, 1st Edition, 2006.
4. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 1st Edition, 2012.

Reference Books:

1. Artificial Neural Networks – B. Yegnanarayana, Prentice Hall of India, 1st Edition, 2004.
2. Artificial Neural Networks – Simon Haykin, Pearson Education, 2nd Edition, 1999.
3. Fundamentals of Neural Networks: Architectures, Algorithms and Applications – Laurene Fausett, Prentice Hall, 1st Edition, 1994.

Course Name: Soft Computing
Course Code: CS(ECS)701D
Contact: 2:0:0
Total Contact Hours: 24
Credit:2

Prerequisites:
Knowledge of set theory, nervous system, and biological evolution

Course Objective(s):

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

O1. make the learners understand the advantages of soft computing techniques
O2.make the learners understand the different aspects of fuzzy logic and fuzzy reasoning
O3.make the learners understand the different aspects of artificial neuralnetworks
O4. make the learners understand the different aspects of genetic algorithm

Course Outcomes (COs):

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

CO1	justify the use of fuzzy logic for decision making in presence of uncertainty
CO2	design a fuzzy logic control system for a continuous-time plant with single i/p-single o/p
CO3	compare the supervised and unsupervised learning techniques in artificial neural networks
CO4	explain the operation of genetic algorithm-based optimization technique

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	-	2	1	1	1	-	-	-	-	-	3	3	3
CO2	3	-	3	1	3	2	-	-	-	-	-	3	2	2
CO3	3	-	1	2	1	3	-	-	-	-	-	3	2	2
CO4	3	-	1	2	1	2	-	-	-	-	-	3	2	3

Course Content:
Module 1: Soft Computing and Fuzzy logic [6L]
Soft-computing-definition, advantage over conventional computing, areas of application Fuzzy Sets,membership function and membership value, linguistic variable

Fuzzy operators, T- Norms and S- Norms
Fuzzy relations, implications, cylindrical extensions, projection Fuzzification and defuzzification

Module 2: Fuzzy reasoning and fuzzy logic control [8L]

Fuzzy extension principle, compositional rule of inference, approximate reasoning (fuzzy reasoning) Different Fuzzy models-Mamdani's model, Sugeno's model (T-S-K model)
Fuzzy logic control system, fuzzy PID controller

Module 3: Genetic algorithm [4L]
Genetic Algorithm (GA)- basic concept, components-chromosome and gene, GA operators,methodsof selection, elitism,Fuzzy-GA system

Module 4: Artificial neural networks [6L]
Artificial neural network (ANN)- basic concept, areas of application, McCulloch and Pitts model, perceptron, realization of logic gates, training of ANN, Supervised and unsupervised learning- techniques and comparison Neuro-fuzzy system

Text Books:

1. An Introduction to Fuzzy Logic Control – *D.* Dirankov, H. Hellendoorn, and M. Reinfrank, Narosa Publishing House, 1st Edition, 2001.
2. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications – S. Rajasekaran and G. A. V. Pai, Pearson Education, 1st Edition, 2003.
3. Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence – J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Pearson Education, 1st Edition, 1997.
4. Fuzzy Logic with Engineering Applications – Timothy J. Ross, Wiley (India), 4th Edition, 2016.

Reference Books:

1. Neural Networks: A Comprehensive Foundati*on* – Simon Haykin, Prentice Hall, 2nd Edition, 1999.
2. *Artificial Neural Networks* – B. Yegnanarayana, Prentice Hall of India, 1st Edition, 2004.

Course Name: Project Management and Finance
Course Code: HU(ECS)701
Contact: 2:0:0
Total Contact Hours:24
Credit: 2

Prerequisites: Basic knowledge of economics and management

Course Objective(s):

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

O1. To introduce students to the fundamental concepts and components of Project Management.
O2. To develop the ability to perform preliminary project screening and appraisal, enabling students to
identify viable project opportunities and assess their potential.
O3. To provide knowledge and analytical skills for conducting comprehensive feasibility studies.
O4. To impart foundational knowledge of Financial Management principles.
O5. To enhance decision-making abilities related to financial management, particularly in areas such as
investment analysis, cost control, and project financing.

Course Outcomes (Cos):

After Successful 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.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**-**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
CO2	**3**	**-**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
CO3	**3**	**-**	**1**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
CO4	**3**	**-**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**

Course Content:

Module 1: BASICS OF PROJECT MANAGEMENT **(2L)**

Meaning, Definition and scope and Need for Project Management - The Project Life Cycle - Phases of Project Management Life Cycle - Project Management Processes.

Module 2: PROJECT IDENTIFICATION AND SELECTION: **(3L)**

Preliminary Screening of Projects. Project Identification Process- Sources of Financial resources - Pre-Feasibility Study - Feasibility Studies: Market Feasibility, Financial Feasibility and Technical Feasibility

Module 3: PROJECT ORGANIZATION AND PLANNING **((3L)**

Project manager, Cross-functional team, Dedicated project organization, Influence project organization, Matrix organization, Advantages and disadvantages of project organizations, Selection of project organization, Work Breakdown Structure (WBS), Integration of project organization and WBS, WBS and responsibility matrix.

Module 4: PROJECT SCHEDULING AND RESOURCE MANAGEMENT **(4L)**

Gant chart, Milestone chart, Network techniques: PERT and CPM, AON and AOA representation

Module 5: NATURE AND SCOPE OF FINANCIAL MANAGEMENT **(2L)**

Role of financial management in business decision, the Firm and its Environment: Forms of business ownership.

Module 6: BALANCE SHEET AND PROFIT AND LOSS STATEMENTS **(6L)**

Tools of Financial Analysis: Funds flow analysis - sources and uses of funds, measurements of cash flow, Revenue costs.

Investment Management: Capital Budgeting Techniques. PBP, ARR, Time Value of Money, NPV v/s IRR. Risk Analysis.

Module 7: PROFIT RELATIONSHIPS **(5L)**

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

Text book:

1. Project Management, R. Panneerselvam and P. Senthil Kumar, PHI Learning Pvt. Ltd., 1st Edition, 2009.

2. Financial Management: Principles and Applications, S. N. Maheshwari, Sultan Chand & Sons, 1st Edition, 2019.
3. Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Prasanna Chandra, McGraw Hill Education (India) Pvt. Ltd., 9th Edition, 2019
4. Project Management, K. Nagarajan, New Age International Publishers, (3rd Edition Reprint, paperback), 2017

Reference Books:

1. Project Management: The Managerial Process, Clifford F. Gray and Erik W. Larson, McGraw-Hill Education, 8th Edition, 2020
2. Financial Management: Text, Problems and Cases, M. Y. Khan and P. K. Jain, McGraw-Hill Education (India), 8th Edition, 2018
3. Project Management, Vasant Desai, Himalaya Publishing House, 2015
4. Guide to the Project Management Body of Knowledge (PMBOK Guide**),** Project Management Institute, 7th Edition, 2021

Course Name: Industrial Automation Lab
Course Code: ECS791
Contact: 0:0:3
Credit: 1.5

Prerequisites:

1. Basic electrical & electronics fundamentals
2. Awareness of sensors and actuators
3. Basic control system concepts
4. Introduction to PLCs

Course Objective(s):

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

O1. provide foundational knowledge and hands-on experience in industrial automation technologies.
O2. develop the ability to design, implement, and troubleshoot basic automation systems used in industrial processes.
O3. prepare students for industry-oriented problem-solving by applying automation tools and techniques in practical scenarios.

Course Outcomes (COs):

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

CO1	Recognize & explain basic elements of an automated process (controller, actuator, final controlelement) via hands on experiment.
CO2	Control different process variable (flow, pressure, level & temperature) using DCS
CO3	Develop and test ladder diagram for different application
CO4	Use SCADA for an automated process

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	2	1	2	1	2	2	2	3
CO2	3	3	3	3	3	1	2	2	2	1	3	2	3	3
CO3	3	3	3	3	3	1	2	2	2	1	3	2	2	1
CO4	3	3	2	3	3	1	2	2	1	1	3	2	2	3

Experiments:

1. Study of an automatic control system
2. Monitoring and control of Temperature Control Loop using DCS

3. Monitoring and control of Pressure Control Loop using DCS
4. Monitoring and control of Flow Control Loop using DCS
5. Monitoring and control of Level Control Loop using DCS
6. Studyof PLC field device interface modules (AI,AO,DI,DO modules) and software
7. Programming Logic Gates Function in PLC Ladder Logic
8. Develop /Execute a ladder program for the given application using following: - timer, counter,comparison,logical, arithmetic instruction.
9. Develop/ test ladder program to blink LED/lamp.
10. Develop Ladder Logic for Traffic Light Control System and test it through PLC using Ton instruction.
11. Logic for counting the objects
12. Use various functions of SCADA simulation editors to develop simple project.

Paper Name: Rapid Prototyping Design Laboratory
Paper Code: PR(ECS)791
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Basic programming (C/C++ or Python), digital electronics, sensors and actuators.

Course Objective(s):

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

O1: Introduce students to tools and techniques used in rapid prototyping.

O2: Enable students to design and simulate embedded and real-time systems using LabVIEW.

O3: Develop hands-on skills for integrating sensors, actuators, and embedded controllers.

O4: Promote innovation through project-based learning with a multidisciplinary approach.

Course Outcomes (COs):

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

CO No.	Course Outcome
CO1	Understand the fundamentals of rapid prototyping tools and techniques.
CO2	Demonstrate skills in PCB design and embedded system interfacing.
CO3	Develop and simulate embedded systems using LabVIEW.
CO4	Apply LabVIEW for sensor data acquisition and control applications.
CO5	Collaborate in a team to develop functional prototypes for real-world problems.

CO-PO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
CO2	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
CO3	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**
CO4	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO5	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**

Course Content:

List of Experiments: -

1. Introduction to Rapid Prototyping and Fabrication Tools Tinker CAD, Fusion 360 (for enclosure design)

2. PCB Design and Fabrication- Basics, Easy EDA, KiCAD

3. Programming with Arduino and Raspberry Pi Arduino IDE, Python

4. Interfacing Sensors and Actuators- IR, Ultrasonic, Servo, DHT11, Relay, etc.

5. Wireless Communication Protocols- Bluetooth, ZigBee, Wi-Fi (ESP8266)

6. Introduction to LabVIEW using NI LabVIEW

7. Sensor Data Acquisition Using LabVIEW DAQ cards, Arduino-LabVIEW Interface

8. Control Systems Prototyping with LabVIEW PID, PWM, Graph plotting, UI simulation

9. IoT Prototyping (Data logging and cloud integration) Blynk, Thing Speak ect.

10. Mini Project: Complete prototype using embedded systems and LabVIEW or IoT platform Open topic

Suggested Ideas for Prototype:

1. Smart Temperature & Humidity Logger using Arduino and Thing Speak
2. IoT-based Soil Moisture Monitoring System for Smart Agriculture
3. Voice-Controlled Appliance Control System using Google Assistant
4. Industrial Safety Helmet with Gas Detection and Alert System
5. Real-Time Temperature Monitoring using Arduino and LabVIEW
6. Control of DC Motor Speed using LabVIEW PID Controller
7. ESP8266-based Air Quality Monitoring with Cloud Dashboard
8. Wireless ECG Monitoring System using Node MCU
9. IoT-based Fire Detection and Notification System
10. Smart Energy Meter Monitoring using IoT and Google Sheets

Tools & Equipment Required:

1. Hardware: Arduino Uno/Nano, ESP32, Raspberry Pi, Sensors (IR, Ultrasonic, DHT11), Actuators (Motors, Relays)
2. Software: Arduino IDE,NI LabVIEW Community Edition, EasyEDA/KiCAD, Python/Node-RED/Blynk

3. Miscellaneous: DAQ cards (optional), Breadboards, Soldering kits

Text Books :

1. Embedded Systems- Introduction to the MSP432 Microcontroller **,**Author: Jonathan W. Valvano ,Edition: 1st Edition, Create Space Independent Publishing Platform, 2017
2. Getting Started with Arduino**,** Massimo Banzi, Michael Shiloh, 3rd Edition ,Maker Media Year: 2014National Instruments LabVIEW Tutorials
3. Make Electronics Learning Through Discovery**,** Charles Platt,2nd Edition, Maker Media / O'Reilly Media ,Year: 2015
4. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux**,** Derek Molloy, 1st Edition, Wiley,2016
5. Getting Started with the Internet of Things ,Connecting Sensors and Microcontrollers to the Cloud, Cuno Pfister, 1st Edition, O'Reilly Media, 2011

References books:

1. The 8051 Microcontroller and Embedded Systems-Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, 2nd Edition,Publisher: Pearson, 2006
2. Wireless Communications: Principles and Practice, Theodore S. Rappaport, 2nd Edition, Pearson 2002
3. PCB Design for Real-World Design, Chris Schroeder, 1st Edition, Newnes (Elsevier),2006
4. LabVIEW for Everyone: Graphical Programming Made Easy and Fun, Jeffrey Travis, Jim Kring, 3rd Edition, Prentice Hall, 2006
5. Data Acquisition Using LabVIEW, Bruce Mihura, 1st Edition, Prentice Hall 2001

4th Year 8th Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	T	P	Total	
B. PRACTICAL									
1	PRJ	Project	ECS881	Grand Viva	0	0	0	8	4
2	PRJ	Project	ECS882	Internship/Entrepreneurship	0	0	0	8	4
Total of Theory, Practical								16	8