Shri Ramdeobaba College of Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT

An Autonomous College affiliated to Rashtrasant Tukadoji Maharaj Nagpur University,

Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME

2022-2023

B.TECH. (ELECTRONICS AND COMPUTER SCIENCE)

SEMESTER-I											
Sr. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**Maximum Marks**			**ESE Duration (Hrs)**
				L	**T**	**P**		**Continuous Evaluation**	**End Sem Exam**	**Total**	
1	BSC	PHT156	Semiconductor Physics	3	1	0	4	40	60	100	3
2	BSC	PHP156	Semiconductor Physics Lab	0	0	3	1.5	25	25	50	-
3	BSC	MAT153	Mathematics-I	3	0	0	3	40	60	100	3
4	BSC	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	-
5	ESC	ECST101	Programming for Problem Solving	3	0	0	3	40	60	100	3
6	ESC	ECSP101	Programming for Problem Solving Lab	0	0	2	1	25	25	50	-
7	ESC	ECSP102	Electronics and Computer Workshop Lab	0	0	2	1	25	25	50	-
8	HSMC	HUT151	English	2	0	0	2	40	60	100	3
9	HSMC	HUP151	English Lab	0	0	2	1	25	25	50	-
10	ESC	IDT151	Creativity, Innovation & Design Thinking	1	0	0	1	20	30	50	1.5
11	MC	PEP151	Yoga/Sports	0	0	2	0				-
TOTAL				**12**	**1**	**13**	**18.5**				
				26Hrs.							

SEMESTER- II												
Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Maximum Marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	BSC	CHT152	Chemistry	3	1	0	4	40	60	100	3
2	BSC	CHP152	Chemistry Lab	0	0	3	1.5	25	25	50	-
3	BSC	MAT154	Mathematics -II	4	0	0	4	40	60	100	3
4	ESC	ECST103	Network Circuits	3	0	0	3	40	60	100	3
5	ESC	ECST104	Digital Circuits	3	0	0	3	40	60	100	3
6	ESC	ECSP104	Digital Circuits Lab	0	0	2	1	25	25	50	-
7	ESC	ECST105	Object Oriented Programming	3	0	0	3	40	60	100	3
8	ESC	ECSP105	Object Oriented Programming Lab	0	0	2	1	25	25	50	-
9	MC	HUT152	Constitution of India	2	0	0	0				-
TOTAL				**18**	**1**	**7**	**20.5**				
				26Hrs.							

Semester III												
Sr. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**Maximum Marks**			**ESE Duration (Hrs)**
				L	**T**	**P**		**Continuous Evaluation**	**End Sem Exam**	**Total**	
1	ESC	ECST201	Electronic Devices and Circuits	3	1	0	4	40	60	100	3
2	ESC	ECSP201	Electronic Devices and Circuits lab	0	0	2	1	50		50	-
3	PCC	ECST202	Data Structures	3	1	0	4	40	60	100	3
4	PCC	ECSP202	Data Structures Lab	0	0	2	1	50		50	-
5	PCC	ECST203	Digital System Design	3	0	0	3	40	60	100	3
6	PCC	ECSP203	Digital System Design Lab	0	0	2	1	50		50	-
7	PCC	ECST204	Discrete Signals and Systems	3	0	0	3	40	60	100	3
8	PCC	ECSP204	Discrete Signals and Systems Lab	0	0	2	1	50		50	-
9	BSC	MAT 277	Linear Algebra	2	0	0	2	40	60	100	3
10	MC	CHT251	Environmental Sciences	2	0	0	0				
TOTAL				**16**	**2**	**8**	**20**				
				26Hrs.							

Semester IV											
Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Maximum Marks			ESE Duration(Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	PCC	ECST206	Discrete Mathematics	3	1	0	4	40	60	100	3
2	PCC	ECST207	Software Engineering	3	0	0	3	40	60	100	3
3	PCC	ECSP207	Software Engineering Lab	0	0	2	1	50		50	-
4	PCC	ECST208	Computer Architecture and Organization	3	1	0	4	40	60	100	3
5	PCC	ECST209	Embedded System Design	3	1	0	4	40	60	100	3
6	PCC	ECSP210	Hardware System Design Lab	0	0	2	1	50		50	-
7	PCC	ECSP211	SoftwareLab-I	0	0	2	1	50		50	-
8	PCC	ECST212	Statistics for Data Analytics	3	0	0	3	40	60	100	3
9	OEC		Open Elective I	3	0	0	3	40	60	100	3
TOTAL				**18**	**3**	**6**	**24**				
				27Hrs.							

Semester V												
Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Maximum Marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	PCC	ECST301	Operating System	3	0	0	3	40	60	100	3
2	PCC	ECSP301	Operating System Lab	0	0	2	1	50		50	-
3	PCC	ECST302	Design and Analysis of Algorithms	3	1	0	4	40	60	100	3
4	PCC	ECST303	Machine Learning	3	0	0	3	40	60	100	3
5	PCC	ECSP303	Machine Learning Lab	0	0	2	1	50		50	-
6	PCC	ECSP304	SoftwareLab-II	0	0	2	1	50		50	-
7	PEC	ECST305	Programme Elective-I	3	0	0	3	40	60	100	3
8	PEC	ECSP305	Programme Elective-I Lab	0	0	2	1	50		50	-
9	HSMC	MBT	Business Management and Entrepreneurship	3	0	0	3	40	60	100	3
10	OEC		Open Elective II	3	0	0	3	40	60	100	3
TOTAL				**18**	**1**	**8**	**23**				
				27Hrs.							

Programme Elective–I (V Semester)	
ECST305-1/ECSP305-1	SOC Design
ECST305-2/ECSP305-2	Elements of IoT
ECST305-3/ECSP305-3	Image Processing
ECST305-4/ECSP305-4	Cloud Computing

Semester VI												
Sr. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**Maximum Marks**			**ESE Duration (Hrs)**
				L	**T**	**P**		**Continuous Evaluation**	**End Sem Exam**	**Total**	
1	PCC	ECST306	Database Management System	3	0	0	3	40	60	100	3
2	PCC	ECSP306	Database Management System Lab	0	0	2	1	50		50	-
3	PCC	ECST307	Computer Networks	3	0	0	3	40	60	100	3
4	PCC	ECSP307	Computer Networks Lab	0	0	2	1	50		50	
5	PCC	ECST308	Digital VLSI Design	3	0	0	3	40	60	100	3
6	PCC	ECSP308	Digital VLSI Design Lab	0	0	2	1	50		50	
7	PEC	ECST309	Programme Elective II	3	0	0	3	40	60	100	3
8	PEC	ECSP309	Programme Elective II Lab	0	0	2	1	50		50	-
9	PROJ	ECSP310	Project I	0	0	6	3	25	25	50	-
10	OEC		Open Elective III	3	0	0	3	40	60	100	3
TOTAL				**15**	**0**	**14**	**22**				
				29 Hrs.							

Program Elective– II (VI Semester)	
ECST 309-1/ECSP 309-1	System Verilog for Verification
ECST 309-2/ECSP 309-2	IoT Sensors and Devices
ECST 309-3/ECSP 309-3	Deep Learning-I
ECST 309-4/ECSP 309-4	Data Mining and Warehousing

Semester VII												
Sr. No.	**Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**Maximum Marks**			**ESE Duration (Hrs)**
				L	**T**	**P**		**Continuous Evaluation**	**End Sem Exam**	**Total**	
1	PEC	ECST401	Programme Elective III	3	0	0	3	40	60	100	3
2	PEC	ECST402	Programme Elective IV	3	0	0	3	40	60	100	3
3	PCC	ECST403	Information Security and Cryptography	3	0	0	3	40	60	100	3
4	MC	ECST404	Cyber Laws and Ethics	2	0	0	2	40	60	100	3
5	PROJ	ECSP405	Project II	0	0	12	6	50	50	100	-
6	PROJ	ECSP406	Industry Internship Evaluation(6-8weeks)	0	0	2	0		-		-
7	OEC		Open Elective IV	3	0	0	3	40	60	100	3
TOTAL				**14**	**0**	**14**	**20**				
				28Hrs.							

Program Elective–III (VII Semester)		**Program Elective- IV (VII Semester)**	
ECST401-1	VLSI Testing	ECST402-1	Physical Design
ECST401-2	IoT Networks and Protocols	ECST402-2	IoT Programming and Big Data
ECST401-3	Deep Learning-II	ECST402-3	Natural Language Processing
ECST401-4	System Design	ECST402-4	Block Chain

Semester VIII												
Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Maximum Marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1	PEC	ECST407	Programme Elective V	3	0	0	3	40	60	100	3
2	PEC	ECST408	Programme Elective VI	3	0	0	3	40	60	100	3
3	PROJ	ECSP409	Project III	0	0	12	6	50	50	100	-
TOTAL				**6**	**0**	**12**	**12**				
				18Hrs.							
OR											
1	PROJ	ECSP410	Internship (Six Months)	0	0	24	**12**	150	150	300	-

Program Elective-V(VIII Semester)		**Program Elective-VI (VIII Semester)**	
ECST407-1	VLSI Signal Processing	ECST408-1	Nano electronics
ECST407-2	Cybersecurity and Privacy in IoT	ECST408-2	Autonomous Vehicle
ECST407-3	Generative Adversarial Network	ECST408-3	Reinforcement Learning
ECST407-4	Big data web intelligence	ECST408-4	Bioinformatics

Open Electives			
IV semester	**V semester**	**VI semester**	**VII semester**
ECST299-1: Linux for Beginners	ECST398-1: Designing with Arduino	ECST399-1: Designing with Raspberry Pi	ECST498-1: Drone Technology

HONORS Specialization in Electronics and Computer Science

Sr. No.	Semester	Course Code	Course Title	Hours/ week L	T	P	Credits	Maximum Marks Continuous Evaluation	End Sem Exam	Total	ESE Duration (Hrs.)
1	III	ECSTH301	Edge for AI fundamentals	3	0	0	3	40	60	100	3
2	IV	ECSTH401	Embedded Machine Learning	3	0	0	3	40	60	100	3
3	V	ECSTH501	Computer Vision with Embedded Machine Learning	3	1	0	4	40	60	100	3
4	VI	ECSTH601	Business Considerations for Edge Computing	3	1	0	4	40	60	100	3
5	VII	ECSPH701	Project	0	0	8	4	50	50	100	-
				12	**2**	**8**	**18**				

MINOR Specialization in Electronics and Computer Science

Sr. No.	Semester	Course Code	Course Title	Hours per week L	T	P	Credits	Maximum Marks Continuous Evaluation	EndSem Exam	Total	ESE Duration (Hrs)
1	III	ECSTM301	IoT fundamentals	3	0	0	3	40	60	100	3
2	IV	ECSTM401	Sensor Interfacing with Arduino and ESP 8266	3	0	0	3	40	60	100	3
3	V	ECSTM501	Cloud Computing Using Raspberry Pi	3	1	0	4	40	60	100	3
4	VI	ECSTM601	Data Management and Analytics for IoT	3	1	0	4	40	60	100	3
5	VII	ECSPM701	Project	0	0	8	4	50	50	100	-
			Total	**12**	**2**	**8**	**18**				

Syllabus of Semester I B.Tech.

Department of Electronics and Computer Science

Course Code	PHT156				
Category	Basic Science Course				
Course Title	Semiconductor Physics				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	I

Course Outcomes:

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

1. Apply fundamental knowledge of quantum mechanics to examine electrons behaviour in solids at the quantum level.
2. Classify materials on the basis of band theory and its importance for semiconductors.
3. Outline the difference between intrinsic / extrinsic semiconductors and their carrier transport phenomena in semiconductor.
4. Analyze the process of generation and recombination of excess charge carriers in semiconductors along with working principle of P-N junction and Metal-Semiconductor junction diode.
5. Illustrate the working and design aspects for the various photonic devices like LEDs, solar-cells and LASER diodes.

Syllabus:

Module I: Quantum Mechanics Introduction
Wave-particle duality, Heisenberg uncertainty relations, the quantum state wave function and its probability interpretation, Schrödinger's equation, Energies and wavefunctions of a single electron in one-dimensional infinite potentials: formulae, function graphs, number of bound states, tunneling, One electron atom, periodic table, Quantum confinement effects in nanosystems.

Module II: Electronic Materials
Free electron theory, Extension of idea of energy level splitting in molecules to bonding in solids, Energy bands in solids, Kronig-Penny model (to better demonstrate origin of band gaps), Bandgap-based classification of electronic materials: metals, semiconductors, and insulators, E-k diagram, Direct and indirect bandgaps, Valence and conduction bands, Density of states, Fermi-Dirac statistics: Occupation probability of states, Fermi level, Effective mass.

Module III: Intrinsic and Extrinsic Semiconductors
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift Programme.

Module IV: Non-Equilibrium Semiconductors
Carrier generation and recombination, Continuity equation, Ambipolar transport equation, Quasi Fermi Energy levels, Excess Carrier Lifetime, Qualitative introduction to recombination mechanisms, Shockley-Read-Hall Recombination, Surface Recombination.

Module V: Junction Physics
p-n junction, Zero applied bias, forward bias, reverse bias, Metal-semiconductor junction, Schottky barrier, Ideal junction properties, Ohmic contacts, ideal non-rectifying barrier, tunneling barrier, Heterojunctions, Nanostructures, Energy band diagram, two-dimensional electron gas.

Module VI: Light - Semiconductors Interaction
Optical absorption in semiconductors, Light emitting diodes, Principles, Device Structures, Materials, High Intensity LEDs, Characteristics, LASERS, Stimulated emission and photon amplification, Einstein Coefficients, Laser oscillation conditions, Laser diode, Solar Energy Spectrum, photovoltaic device principles, Solar Cells.

Textbook:
Modules 1–5: *Semiconductor Physics and Devices* (Fourth Edition), Donald A. Neamen, McGraw-Hill, 2012.

References:

1. *Physics of Semiconductor Devices*, S. M. Sze, 2nd Edition, Wiley-Interscience Publication, 1986 – Modules 6
2. Online course: *Semiconductor Optoelectronics* by M. R. Shenoy on NPTEL
3. *Optoelectronics and Photonics: Principles and Practices* by S. O. Kasap, Prentice Hall, 2001

Course Code	PHP156				
Category	Basic Science Course				
Course Title	Semiconductor Physics Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	3	1.5	I

Course Outcomes:

The Physics Lab course consists of experiments illustrating the principles of physics relevant to the study of science and engineering.
At the end of the course, the students will learn to:

1. Develop skills required for experimentation and verification of physics laws.
2. Analyse the results obtained through proper graph plotting and error analysis.
3. Conduct experiments to validate physical behaviour of materials/components.
4. Analyse the behaviour and characteristics of P-N Junction, Zener-Diode and other semiconductor devices.
5. Prepare laboratory reports on interpretation of experimental results.

In addition to the General Physics experiments, the lab turns will be utilized for performing the experiments based on the following lists as specific to the program:

General Physics

1. Error analysis and graph plotting
2. Newton's law of cooling
3. Simple Pendulum
4. Magnetic flux using deflection magnetometer
5. Dispersive power and determination of Cauchy's constants
6. Data analysis using Mathematica
7. Cathode Ray Oscilloscope

Semiconductor Physics and Devices

1. Energy gap of semiconductor / thermistor
2. Study of Hall Effect
3. Parameter extraction from I-V characteristics of a PN junction diode
4. Parameter extraction from I-V characteristics of a Zener diode
5. Study of diode rectification
6. Parameter extraction from I-V characteristics of a transistor in common-emitter configuration
7. V-I Characteristics of Light Emitting Diodes
8. Study of a photodiode
9. Solar Cell (Photovoltaic cell)
10. Resistivity measurement by Four Probe method

A minimum of 8 experiments to be performed from the following list of experiments

Course Code	MAT153				
Category	Basic Science Course				
Course Title	Mathematics-I				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	I

Course Outcomes:

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that model physical processes.
2. The essential tool of matrices in a comprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and the basic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus:

Module I: First Order Ordinary Differential Equations (7 Hrs)
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module II: Ordinary Differential Equations of Higher Orders (8 Hrs)
Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module III: Basic Statistics (7 Hrs)
Curve fitting by the method of least squares – fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation.

Module IV: Basic Probability (8 Hrs)
Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module V: Matrices (10 Hrs)
Algebra of matrices, Inverse and rank of a matrix, Rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Topics for Self-Learning:

Applications of Differential Equations.

Textbooks / References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.
4. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B. S. Grewal, Higher Engineering Mathematics, 35th Edition, Khanna Publishers, 2000.
7. J. R. Spiegel, Theory and Problems of Probability and Statistics, 2nd Edition, Schaum's Outline Series.
8. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Volume I & II, Pune Vidyarthi Griha Prakashan, Pune – 411030 (India).
9. S. Ross, A First Course in Probability, 6th Edition, Pearson Education India, 2002.

Course Code	MAP151				
Category	Basic Science Course				
Course Title	Computational Mathematics Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	I

Course Outcomes:

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyse the data in the lab and draw valid conclusions.

At the end of the course, the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working, and application of areas in mathematics and compare the results obtained with theoretical calculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.

The lab turns will be utilized for performing the experiments based on the following list:

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Reference:

1. *Computational Mathematics Lab Manual*, written by the Teaching Faculty of Mathematics Department, RCOEM.

Course Code	ECST101				
Category	Engineering Science Course				
Course Title	Programming for Problem Solving				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	I

Course Outcomes:

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

1. Develop the fundamentals of C programming and choose the loops and decision-making statements to solve and execute the given problem.
2. Formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs, test and execute the programs, and correct syntax and logical errors.
3. Use arrays, pointers, structures, and I/O operations for the formulation of algorithms and programs.
4. Apply programming concepts to solve matrix addition, multiplication problems, and searching & sorting problems.
5. Implement iterations and recursions, decompose a problem into functions, and synthesize a complete program using the divide and conquer approach.

Syllabus:

Module I: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers, etc.).
Idea of Algorithm: Steps to solve logical and numerical problems.
Representation of Algorithm: Flowchart / Pseudo code with examples.
Arithmetic expressions and precedence.

Module II: C Programming Language
Introduction to C language: Keywords, Constants, Variables, Data types, Operators, Types of Statements, Preprocessor Directives.
Decision Control Statements – if, if-else, nested if-else, switch-case.
Loops and writing/evaluation of conditionals and consequent branching.

Module III: Arrays and Basic Algorithms
Arrays: 1-D, 2-D, Character arrays, and Strings.
Searching, Basic Sorting Algorithms (Bubble, Insertion, Selection).
Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

Module IV: Functions and Recursion
User-defined and Library Functions, Parameter passing in functions (call by value), passing arrays to functions, idea of call by reference.

Recursion as an alternate way of solving problems.
Example programs: Finding Factorial, Fibonacci Series, Ackermann Function, Quick Sort or Merge Sort.

Module V: Pointers and Structures
Structures: Defining structures, Array of Structures.
Introduction to Pointers: Defining pointers, pointer arithmetic, pointer operators.
Use of Pointers in self-referential structures.
Notion of linked list (no implementation required).

Module VI: File Handling
Streams in C, Types of Files, File Input/Output Operations.
Modes of file opening, Reading and Writing the file, Closing the files, using `fflush()`.

Textbooks:

1. *Programming in ANSI C* – E. Balagurusamy, McGraw Hill
2. *Mastering C* – K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

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Reference Books:

1. *Programming with C* – Byron Gottfried, Schaum's Outline Series
2. *Let Us C* – Yashwant Kanetkar, BPB Publication

Course Code	ECSP1001				
Category	Engineering Science Course				
Course Title	Programming for Problem Solving Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	I

List of Experiments

1. Using basic data types of C, implement arithmetic expressions.
2. Implement Programs using Decision Control Structures
3. Demonstrate use of Loop Control Structures
4. Implement Programs using Multi-way Decision Control Structures (Switch Case)
5. Apply Functions and Recursion to simplify programs.
6. Initialize array and apply it to solve problems of 1D and 2D arrays.
7. Demonstrate use of Structures and Pointers.
8. Apply file handling concepts in C.

Note: 2/3 Practice Programs will be taken on each of the experiments mentioned above.

Course Code	ECSP102				
Category	Engineering Science Course				
Course Title	Electronics and Computer Workshop Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	I

Course Outcomes:

Upon the completion of this course, students will demonstrate the ability to:

1. Inspect techniques to identify and test different electronic components and integrated circuits.
2. Comprehend different EDA tools required for designing electronic and computer-related circuits.
3. Classify mounting and troubleshooting practices and perform OS installation and imaging.

Practical’s Based On:

1. Acquaintance with basic electronic components, reading of datasheets, and integrated circuits.
2. Introduction to electronic test and measurement equipment (Multimeter, CRO, DSO, Function Generator, Power Supply, etc.).
3. Test and measurement of resistor, capacitor, inductor, P-N junction diode using Multimeter and DSO.
4. Introduction to EDA tools.
5. Circuit implementation and testing on breadboard.
6. Component mounting and soldering on PCB.
7. Assembling and disassembling CPU and identification of peripherals.
8. Processor mounting and troubleshooting practices.
9. USB, Ethernet, HDMI, Thunderbolt port variants (peripherals).
10. Types of Operating Systems, OS installation, and OS imaging.

Textbooks:

1. *K. A. Navas*, Electronics Lab Manual, Fifth Edition, PHI Learning, 2015
2. *N. Kumar, T. H. Sheikh*, PC Assembly and Installation, Books Clinic Publishing, 2020

Reference Books:

1. *C. Bhargava*, Digital Electronics: A Comprehensive Lab Manual, BS Publication, 2019
2. *C. Zacker*, PC Hardware: The Complete Reference, First Edition, McGraw Hill Education, 2017

Course Code	HUT151				
Category	Basic Science Course				
Course Title	English				
Scheme & Credits	L	T	P	Credits	Semester
	2	0	0	2	I

Course Outcomes:

Upon the completion of this course, students will be able to:
CO1. Demonstrate correct use of word power in written as well as oral communication.
CO2. Apply the principles of functional grammar in everyday as well as professional communication.
CO3. Create precise and accurate written communication products.
CO4. Objectively apply various writing styles.
CO5. Effectively implement the comprehensive principles of written communication.
CO6. Employ techniques of listening and reading comprehension in professional communication.

Syllabus:

Module I: Vocabulary Building
The concept of Word Formation, Techniques to develop word power: root words from foreign languages, affixes, games, etc.
Commonly used power verbs, adjectives and adverbs.
Synonyms, antonyms, phrases & idioms, one-word substitutions, and standard abbreviations.

Module II: Identifying Common Errors in Writing
Articles, prepositions, modifiers, modal auxiliaries, tenses.
Subject-verb agreement, noun-pronoun agreement.
Active–passive voice.

Module III: Basic Writing Skills
Sentence Structures.
Importance of proper punctuation.
Creating coherence.
Organizing principles of paragraphs in documents.
Techniques for writing precisely.

Module IV: Nature and Style of Sensible Writing
Describing, Defining, Classifying.
Providing examples or evidence.

Module V: Writing Practices
Précis Writing, Essay Writing, Email Writing.
Note Making (with reference to GD, Meetings, Presentations, and Feedback).

Module VI: Reading and Listening Comprehension
Reading Comprehension: purpose, types, strategies, and practice.
Listening Comprehension: active listening, reasons for poor listening, traits of a good listener, barriers in listening, and practice.

Textbooks/References:

1. *Communication Skills* – Sanjay Kumar and Pushp Lata, Oxford University Press, 2011
2. *Practical English Usage* – Michael Swan, OUP, 1995
3. *Remedial English Grammar* – F.T. Wood, Macmillan, 2007
4. *On Writing Well* – William Zinsser, Harper Resource Book, 2001
5. *Study Writing* – Liz Hamp-Lyons and Ben Heasly, Cambridge University Press, 2006
6. *Exercises in Spoken English* (Parts I-III), CIEFL, Hyderabad, Oxford University Press

Course Code	HUP151				
Category	Basic Science Course				
Course Title	English Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	I

Course Outcomes:

Upon the completion of this course, students will:
CO1: Apply effective listening and speaking skills.
CO2: Demonstrate the techniques of effective presentation skills.
CO3: Analyze and apply effective strategies for personal interviews.
CO4: Evaluate and apply effective strategies for group discussions.
CO5: Implement essential language skills — listening, speaking, reading, and writing.

List of Practical's:

1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation, Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations: Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion - Orientation
8. Communication at Workplace: Practice Session

Course Code	IDT151				
Category	Multidisciplinary Course				
Course Title	Creativity, Innovation & Design Thinking				
Scheme & Credits	L	T	P	Credits	Semester
	1	0	0	1	I

Course Outcomes:

1: Be familiar with processes and methods of creative problem solving
2: Enhance their creative and innovative thinking skills
3: Practice thinking creatively and innovative design and development

Syllabus:

Module I: Introduction: Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

Module II: Pattern Breaking: Thinking differently, Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brain-writing, The SCAMPER methods, Metaphoric thinking, Outrageous thinking, Mapping thoughts, Other (new approaches)

Module III: Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

Module IV: Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats, Ethical considerations

Module V: Design for Innovation: Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

Module VI: Intellectual Property: Introduction to intellectual property: Patents, Copyrights, Trademarks, Trade Secret, Unfair Competition

Textbook and Reference Books:

1. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching Creativity and Problem Solving - By Arthur B Vangundy - Pfeiffer
3. H. S. Fogler and S. E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill
5. J. Goldenberg and D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002.

Course Assignments for internal continuous assessment of 20 Marks (NOT 1 and T2):

- Brainteasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)
- Small teams presentations on innovation:
  (1) innovative individual,
  (2) innovative company,
  (3) innovative movie/game,
  (4) sustainable innovation,
  (5) innovation in business,
  (6) innovation in art,
  (7) innovation in architecture,
  (8) innovative nation,
  (9) innovation in science, and
  (10) innovation in engineering
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

Course Code	PEP151				
Category	Basic Science Course				
Course Title	Yoga/Sports				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	0	I

Course Outcome:

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

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtain health-related physical fitness.
3. Develop body-mind coordination through games and yoga.
4. Change sedentary lifestyles towards active living.

Brief Objectives of Sports/Yoga Practical Classes:

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, the Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness, and wellness of students as well as create awareness about the need for good health and physical fitness. The objective would also be to foster all-round development with team spirit, social values, as well as to identify and develop leadership qualities in students through various sports activities.

Sports activities would also be conducted with the objective to provide better interaction and recreation to the students, which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health-related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

Sports:

1. Introduction to sports offered by the department.
2. Health and safety issues related to sports; knowledge, recognition, and ability to deal with injuries and illness associated with sports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

Yoga:
Includes various sitting, standing, and lying Asanas, Surya Namaskars, and Pranayamas.

Physical Efficiency Tests:
This includes 6 health-related physical fitness tests.

Syllabus of Semester II B.Tech.

Department of Electronics and Computer Science

Course Code	CHT152				
Category	Basic Science Course				
Course Title	Chemistry				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	II

Course Outcomes:

After the successful completion of the course, students shall be able to:

1. Predict the properties and interactions of chemical substances at the atomic level.
2. Interpret the unique properties of nano-materials to solve challenges in life.
3. Explain the differences in the mechanical behavior of engineering materials based on bond type, structure, composition, and processing.
4. Examine chemical kinetics using concepts of computational chemistry.
5. Discuss how spectroscopic methods are used for qualitative and quantitative analyses.
6. Understand the importance of biomaterials.

Syllabus:

Module I: Chemical Bonding (7 Hrs)

- Bonding in atoms: Primary bonding — ionic, covalent, metallic.
- Secondary bonding — dipole-dipole, induced dipole-induced dipole, London dispersion/van der Waals, hydrogen bonding.
- LCAO-MO Electronic material: Band theory — metals, insulators, and semiconductors.
- Band gaps, doping, silicon wafer production.
- Integrated circuits, Light Emitting Diodes (LEDs).

Module II: Nano-materials (7 Hrs)

- Basics of Nanochemistry: Definition of Nano, carbon age — new forms of carbon (CNT to Graphene).
- One-dimensional, two-dimensional, and three-dimensional nanostructured materials.
- Mechanical, physical, chemical, optical properties.
- Application of Nanomaterials: Molecular electronics and nanoelectronics.
- Nanotechnology for waste reduction and improved energy efficiency.
- Carbon Nanotubes for energy storage.
- Hydrogen storage in Carbon Nanotubes.

Module III: Advanced Materials (7 Hrs)

- Introduction to Composites and their classification: Ceramic, Carbon–Carbon composites, Fiber-Reinforced composites and applications.
- Reinforcements: Kevlar, silicon carbide, boron carbide.
- Industrial Polymers: Thermoplastics, Thermosetting plastics.
- Polymers used in electronic industries and optical media data storage devices.

Module IV: Computational Chemistry (6 Hrs)

- Rate of reaction, order and molecularity of reaction.
- Rate expression for zero order, first order, and second order reactions.
- Effect of temperature on reaction rates.
- Use of computational tools for determining rate of reaction.

Module V: Material Characterization using Different Spectroscopic Techniques (7 Hrs)

- Fundamentals of spectroscopy.
- Infrared Spectroscopy (IR).
- Electronic Spectroscopy.
- Nuclear Magnetic Resonance Spectroscopy (NMR).
- Fundamentals of X-Ray Diffraction (XRD).

Module VI: Biomaterials (8 Hrs)

- Introduction to biomaterials.
- Metallic biomaterials like stainless steel, Co-Cr alloy.
- Corrosion of metallic implants.
- Ceramic biomaterials like calcium phosphate, bioactive or surface-reactive biomaterials.
- Biodegradable polymers.
- Biocompatibility.

Textbooks:

1. Shikha Agrawal, *Engineering Chemistry: Fundamentals and Applications*, Cambridge University Press.
2. Dr. Rajshree Khare, *A Textbook of Engineering Chemistry (AICTE)*, S.K. Kataria & Sons.
3. S.S. Dara, *A Textbook of Engineering Chemistry*, S. Chand Publications.

Reference Books:

1. J. Michael Hollas, *Modern Spectroscopy*, 4th Edition, John Wiley and Sons, 2004.
2. William Kemp, *Organic Spectroscopy*, 3rd Edition, Palgrave Publication, 1991.
3. Bradley D. Fahlman, *Materials Chemistry*, 3rd Edition, Springer Nature, 2018.
4. Brian W. Pfennig, *Principles of Inorganic Chemistry*, John Wiley and Sons, 2015.
5. Steven S. Zumdahl, Donald J. DeCoste, *Chemical Principles*, 8th Edition, Cengage Learning, 2017.
6. Catherine E. Housecroft and Edwin C. Constable, *Chemistry: An Introduction to Organic, Inorganic and Physical Chemistry*, 3rd Edition, Pearson Education Limited, 2006.
7. Michael J. Moran and Howard N. Shapiro, *Fundamentals of Engineering Thermodynamics*, 5th Edition, John Wiley and Sons, 2006.
8. Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan, *Introduction to Spectroscopy*, 5th Edition, Cengage Learning, 2009.
9. C.N.R. Rao, A. Muller, and A.K. Cheetham, *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*, Wiley-VCH, 2004.
10. P.C. Jain and Monica Jain, *Engineering Chemistry*, Dhanpat Rai Publication.
11. J.D. Lee, *Concise Inorganic Chemistry*, 4th Edition, Chapman and Hall Publications.
12. Joon B. Park and Joseph D. Bronzino, *Biomaterials: Principles and Applications*, CRC Press.
13. C. Mouli Agrawal, Joo Long, Mark R. Appleford, and Gopinath Mani, *Introduction to Biomaterials*.
14. U. Sattyanarayana, U. Chakrapani, *Biochemistry*, Elsevier Publications.

Course Code	CHP152				
Category	Basic Science Course				
Course Title	Chemistry Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	3	1.5	II

Course Outcomes:

The chemistry laboratory course consists of experiments illustrating fundamental chemistry principles relevant to science and engineering. Upon completion, students will be able to:

1. Estimate the amount of different impurities in water/wastewater samples.
2. Measure molecular system properties of liquids/oils such as surface tension, viscosity, acid value, and saponification number.
3. Estimate rate constants of reactions and the order of reactions, and/or validate adsorption isotherms.
4. Understand the basics of synthesis of nanomaterials, polymers, or drug molecules and use spectroscopic techniques to determine their properties.

List of Experiments:

(Any Eight from the List)

1. Preparation of different solutions: Molar solution, Normal solution, and Percent solution and determination of concentration.
2. Identification and estimation of types of alkalinity in water samples.
3. Estimation of temporary, permanent, and total hardness in water samples using complexometric titration method.
4. Determination of the rate of a reaction at room temperature and analysis of experimental data using computational software.
5. Study of chemical kinetics of peroxydisulphate and iodide ion reactions to find the order of reaction and analyze experimental data using computational software.
6. Study of the optical properties of nanomaterials.
7. Determination of relative and kinematic viscosities of aqueous solutions of Polyethylene Glycol (polymeric liquid) using Redwood Viscometer (Type I or II) at different temperatures and analysis using computational tools.
8. Study the effect of bonding of water molecules with electrolytes (NaCl/KCl) and non-electrolyte solutes (Soap) through surface tension determination.
9. Study of ion-exchange columns for removal of hardness in water samples.
10. Prediction of IR/NMR spectra of materials using open-source computational tools.
11. Demonstration of inorganic spectral techniques: XRD and XRF.
12. Spectroscopic/Colorimetric determination of wavelength of maximum absorption of chemical/biological compounds in solution and determination of concentration using Lambert-Beer's Law.
13. Acid-base titration and data analysis using computational tools.

Course Code	MAT154				
Category	Basic Science Course				
Course Title	Mathematics-II				
Scheme & Credits	L	T	P	Credits	Semester
	4	0	0	4	II

Course Outcomes:

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

1. Understand the implications of Mean Value Theorems, fundamental to applying analysis to engineering problems involving functions of several variables across various branches of engineering.
2. Grasp the basics of improper integrals, Beta and Gamma functions, curve tracing, and the tools of power series and Fourier series for advanced engineering mathematics.
3. Apply multivariable integral calculus and vector calculus concepts to solve engineering problems.

Syllabus:

Module I: Differential Calculus (12 Hours)

- Taylor's and Maclaurin's series expansions
- Radius of curvature (Cartesian form), evolutes and involutes
- Limit and continuity of functions of several variables and their partial derivatives
- Euler's Theorem, Chain rule, Total derivative, Jacobians
- Maxima, minima, and saddle points
- Method of Lagrange multipliers

Module II: Integral Calculus (6 Hours)

- Evaluation of definite and improper integrals
- Beta and Gamma functions and their properties
- Curve tracing (Cartesian form)

Module III: Sequences and Series (7 Hours)

- Convergence of sequences and series
- Tests for convergence
- Power series
- Fourier series: Half-range sine and cosine series
- Parseval's theorem

Module IV: Multiple Integrals (10 Hours)

- Double and triple integrals (Cartesian and polar coordinates)
- Change of order of integration in double integrals
- Change of variables (Cartesian to polar)
- Applications: area, mass, and volume by double integration
- Center of mass and gravity (basic concepts)

Module V: Vector Calculus (10 Hours)

- Vector differentiation: directional derivatives, total derivative, gradient, curl, divergence
- Vector integration
- Theorems of Green, Gauss, and Stokes and their applications

Topics for Self-Learning:

- Rolle's theorem, Mean value theorems
- Indeterminate forms
- Maxima and minima for functions of one variable
- Geometrical interpretation of partial differentiation (tangent plane and normal line)
- Applications of definite integrals to evaluate perimeter, area, surface areas, and volumes of revolution

Textbooks / References:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons, 2006.
2. T. Veerarajan, *Engineering Mathematics for First Year*, Tata McGraw-Hill, New Delhi, 2008.
3. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 35th Edition, 2000.
4. B.V. Ramana, *Higher Engineering Mathematics*, Tata McGraw Hill, New Delhi, 11th Reprint, 2010.
5. P.N. Wartikar and J.N. Warlike, *A Textbook of Applied Mathematics Volume I & II*, Pune Vidhyarthi Griha Prakashan, Pune, India.

Course Code	ECST103				
Category	Engineering Science Course				
Course Title	Network Circuits				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	II

Course Outcomes

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

1. Understand basic electrical circuits using node and mesh analysis techniques.
2. Apply network theorems for effective analysis of electrical circuits.
3. Appreciate and utilize the Laplace Transform for steady-state and transient circuit analysis.
4. Analyze two-port network circuits with various interconnections.

Syllabus

Module I (7 Hours): Circuit Analysis

- Kirchhoff's Voltage Law (KVL) and Kirchhoff's Current Law (KCL)
- Circuit elements: Resistor (R), Inductor (L), Capacitor (C) in series and parallel
- Voltage and current divider rules
- Source transformation techniques
- Duals and duality concepts
- Mesh analysis and supermesh analysis
- Nodal analysis and super nodal analysis

Module II (7 Hours): Network Theorems

- Superposition Theorem
- Thevenin's Theorem
- Norton's Theorem
- Maximum Power Transfer Theorem
- Reciprocity Theorem
- Application of these theorems to DC and AC circuits

Module III (7 Hours): Electrical Circuit Analysis Using Laplace Transforms

- Review of Laplace Transform and partial fractions
- Singularity functions
- Analysis of electrical circuits using Laplace transform for standard inputs
- Convolution integral
- Inverse Laplace transform
- Evaluation of initial conditions
- Transformed network with initial conditions

Module IV (7 Hours): S Domain Analysis

- Analysis of RC, RL, and RLC networks with and without initial conditions using Laplace transform
- Transient behavior analysis
- Evaluation of initial conditions
- Waveform synthesis

Module V (7 Hours): Two Port Networks

- Concept of Two Port Networks and terminal pairs
- Relationship of two-port variables
- Impedance parameters (Z-parameters)
- Admittance parameters (Y-parameters)
- Transmission parameters (ABCD parameters)
- Hybrid parameters (h-parameters)
- Interconnections of two-port networks

Textbooks:

1. M. E. Van Valkenburg, *Network Analysis*, Prentice Hall, 2006.
2. Roy Choudhury, *Networks and Systems*, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, *Engineering Circuit Analysis*, McGraw Hill Education, 2013.

Reference Books:

1. Sudhakar, A., Shyammohan, S. P., *Circuits and Network*, Tata McGraw Hill, New Delhi, 1994.
2. C. K. Alexander and M. N. O. Sadiku, *Electric Circuits*, McGraw Hill Education, 2004.
3. K. V. V. Murthy and M. S. Kamath, *Basic Circuit Analysis*, Jaico Publishers, 1999.

Course Code	ECST104				
Category	Engineering Science Course				
Course Title	Digital Circuits				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	II

Course Outcomes

Upon the completion of this course, students will demonstrate the ability to:

1. Apply various optimization techniques to minimize digital circuits.
2. Design combinational logic circuits.
3. Analyze and design asynchronous and synchronous sequential circuits.
4. Discuss x86 architecture

Syllabus

Module I (6 Hrs)
Basics of Digital Electronics:
Motivation for digital systems: Number Systems and arithmetic's, Logic and Boolean algebra, logic gates & truth tables, SOP, POS, Minimization of combinational circuits using Karnaugh-maps.

Module II (6 Hrs)
Combinational Circuit Design:
Multiplexers, De-multiplexers, Encoders, Decoders, Code Converters, Adders, Subtractor (Half, Full), BCD Adder/ Subtractor, ripple and carry look-ahead addition, Unsigned Multiplier.

Module III (6 Hrs)
Sequential Circuit Design - I:
Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops: level triggered, edge triggered, Master Slave flip-flop, flip flop conversion, timing analysis.

Module IV (6 Hrs)
Sequential Circuit Design - II:
Design of asynchronous and synchronous counters, Registers & Shift registers, Application of shift register: ring counter, Johnson counter, sequence generator and detector, serial adder; Linear feedback shift register (LFSR)

Module V (6 Hrs)
Design of synchronous sequential circuit using Mealy model and Moore model:
State transition diagram, algorithm state machine (ASM) chart

Module VI (5 Hrs)
Introduction to X86 architecture.

Text Books:

1. Donald P. Leach, Albert P. Malvino and Goutam Saha, "Digital Principles & Applications 8e", McGraw Hill
2. Douglas V. Hall "Microprocessors and Interfacing" Tata McGraw Hill Education Private Limited, 2005

Reference Books:

1. Thomas L Floyd, "Digital Fundamentals 9e", Pearson
2. M. Morris Mano and Michael D. Ciletti, "Digital Design 5e", Pearson
3. Taub and Shilling, "Digital Integrated Electronics", McGraw Hill
4. A Anand Kumar, "Fundamentals of Digital Circuits" Fourth Edition, PHI
5. Kip R. Irvine, "Assembly Language for x86 Processors" Seventh Edition, Pearson Education

Course Code	ECST105				
Category	Engineering Science Course				
Course Title	Object Oriented Programming				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	II

Course Outcomes:

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

1. Understand the principles of object-oriented programming; create classes, instantiate objects and invoke methods.
2. Apply the concepts of generics and implement collection classes and develop reusable programs using the concepts of OOP.
3. Apply the concepts of Multithreading and Exception handling to develop efficient and error-free codes for solving classic synchronization problems.
4. Create design pattern in software design process.

Syllabus:

Module I: (6 Hrs)
Features of Object-Oriented Programming languages, Abstraction, Encapsulation, Inheritance, polymorphism and late binding. Concept of a class, Access control of members of a class, instantiating a class, constructor and method overloading and overriding.

Module II: (6 Hrs)
Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism, abstract classes and methods, Interface, implementation of interface, creating packages, importing packages, static and non-static members, Lambda Expressions Introduction, Block, Passing Lambda expression as Argument.

Module III: (5 Hrs)
Exceptions, types of exception, use of try-catch block, handling multiple exceptions, using finally, throw and throws clause, user defined exceptions, file handling in Java, Serialization.

Module IV: (6 Hrs)
Generics, generic class with two type parameter, bounded generics. Collection classes: ArrayList, LinkedList, HashSet, TreeSet.

Module V: (6 Hrs)
Multithreading: Java Thread models, creating thread using Runnable interface and extending Thread, thread priorities, Thread Synchronization, Inter Thread communications.

Module VI: (6 Hrs)
Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, and Role of Design Pattern in Software Design, Creational Patterns, Structural Design Patterns and Behavioural Patterns.

Text Books:

1. Herbert Schildt; *JAVA, the Complete Reference*; Ninth Edition, Tata McGraw-Hill Publishing Company Limited.
2. *Design Patterns* by Erich Gamma, Pearson Education.

Reference Books:

1. Cay S. Horstmann and Gary Cornell; *Core JAVA Volume-II Advanced Features*; Eighth Edition; Prentice Hall, Sun Microsystems Press 2008.
2. Herbert Schildt and Dale Skrien; *Java Fundamentals: A Comprehensive Introduction*; Tata McGraw-Hill Education Private Ltd 2013.

Course Code	ECSP105				
Category	Engineering Science Course				
Course Title	Object Oriented Programming Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	II

List of Experiments

1. Implement the Classes and Objects in Java.
2. Implement a program in Java with Constructors and Destructors. Also implement the concept of Overloading.
3. Demonstrate use of Inheritance.
4. Implement a concept of Interface in Java.
5. Demonstrate use of MultiThreading.
6. Implement Packages and import that package in program.
7. Demonstrate use of Exception Handling Mechanism.
8. Apply concept of Generics Class and Method.
9. Demonstrate Collection Framework and perform some basic operations on the ArrayList and HashSet.
10. Apply File Handling concepts in Java.

Course Code	HUT152				
Category	Basic Science Course				
Course Title	Constitution of India				
Scheme & Credits	L	T	P	Credits	Semester
	2	0	0	0	II

Course Outcomes:

On successful completion of the course, students will:

1. Understand the role of constitution in democratic India
2. Act responsibly as citizens of India by knowing their fundamental rights and duties
3. Analyze the working of a democratic government and constructively participate in all the democratic functions that are expected from the citizens
4. Interpret the implementations of constitutional and other laws in the federal structure established by the constitution

Course Content:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitutional powers and status of the President of India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy and social justice
11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Text Book:

1. Durga Das Basu, *“An Introduction to Constitution of India”*, 22nd Edition, Lexis Nexis.

Syllabus of Semester III B.Tech.

Department of Electronics and Computer Science

Course Code	ECST201				
Category	Engineering Science Course				
Course Title	Electronic Devices and Circuits				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	1	5	III

Course Outcomes

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

1. Identify the region of operation of PN Junction Diode and MOSFET.
2. Design rectifier, clipper, clamper, and voltage regulator using diodes.
3. Apply the mathematical models of MOS transistors for circuits and systems design.
4. Examine the effect of negative feedback on gain, bandwidth, input and output impedance, and the stability of the amplifier.
5. Design, test, and analyze operational amplifier-based circuits/systems.

Syllabus

Module I: (7 Hrs)
Diode Models and Circuits:
Terminal Characteristics of Junction Diodes, Models of P-N Junction Diode, Small-Signal Model. Operation in the Reverse Breakdown Region—Zener Diodes, Zener as a Shunt Regulator, Applications of PN junction diode ─ Rectifier, Clipper, Clamper, DC power supply, Diode Logic Gates.

Module II: (8 Hrs)
Two Terminal MOS Capacitor:
MOS capacitor, Accumulation, Depletion and Inversion region of operation, Charge Distribution, Depletion Layer Thickness, Flat-Band Voltage, Threshold Voltage. Capacitance-Voltage characteristics: Ideal C-V Characteristics, Frequency Effects, Fixed Oxide and Interface Charge Effects.

Module III: (8 Hrs)
MOS Field Effect Transistor:
Device structure and physical operation, Current–Voltage Characteristics, MOSFET circuits at DC, MOSFET in Amplifier Design: The Voltage-Transfer Characteristic (VTC), biasing the MOSFET to obtain linear amplification, Small-Signal Voltage Gain, Small-Signal Operation and Model.

Module IV: (8 Hrs)
Feedback Amplifier and Op-Amp Fundamentals:
General Feedback Amplifier Structure, Properties of Negative Feedback, Characteristics of Operational Amplifier, Open Loop Op-Amp, Basic Inverting and Non-Inverting Op-Amp Amplifiers with Negative Feedback, Op-Amp Parameters & Their Analysis.

Module V: (7 Hrs)
Op-Amp Linear and Nonlinear Applications:
Voltage Follower, Summing Amplifiers, Integrators and Differentiators, Difference Amplifiers & Instrumentation Amplifiers, Comparators, Schmitt Trigger Circuits, Sample/Hold Circuits, Digital to Analog Converters, Analog to Digital Converters.

Module VI: (7 Hrs)
Oscillators and Active Filters Design:
Precision Rectifiers, Oscillators: Basic Concept, Op-Amp Based Sinusoidal Oscillators, Design of Active Filters.

Textbooks:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar: *Microelectronic Circuits: Theory and Applications*, Seventh Edition, Oxford University Press, 2017.
2. Sergio Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, Fourth Edition, McGraw-Hill Education, 2014.

Reference Books:

1. Donald Neamen, *Electronic Circuits: Analysis and Design*, Third Edition, McGraw-Hill Publication, 2006.
2. Ramakant Gayakwad, *OP-AMPS and Linear Integrated Circuits*, 4th Edition, PHI.
3. Jacob Millman, Christos Halkias, Chetan Parikh: *Millman's Integrated Electronics*, Second Edition, McGraw Hill Education, 2017.
4. Coughlin Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, 4th Edition, PHI.
5. D. Roy Choudhary, Shail Jain, *Linear Integrated Circuits*, 4th Edition, New Age International.

Course Code	ECST202				
Category	Programme Core Course				
Course Title	Data Structures				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	1	5	III

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

1. Understand the concepts of data structures.
2. Apply the concepts of linear (stacks, queues, linked lists) and non-linear (trees, graphs) data structures.
3. Implement different searching and sorting techniques.
4. Demonstrate the use and applicability of data conversion techniques.
5. Devise algorithms for solving real-world problems.

Syllabus

Module I: (5 Hrs)
Understanding data structures and algorithms, Python for data, Variables and expressions, Flow control and iteration, Overview of data types, objects and Python modules, Types of Data Structures – User defined, Built-in data types: List, Set, Dictionary, Tuple.

Module II: (5 Hrs)
Linear Data Structure – Arrays, Pointer structures, Nodes, Representation of arrays, Applications of arrays, Sparse matrix and its representation.

Module III: (6 Hrs)
Stack: Definitions & Concepts, Operations on Stacks, Applications of Stacks
Queue: Representation of Queue, Operations on Queue, Applications of Queue
Linked List: Singly Linked List, Doubly Linked List, Circular Linked List, Linked Implementation of Stack, Linked Implementation of Queue, Applications of Linked List.

Module IV: (7 Hrs)
Nonlinear Data Structure:
Tree – Definitions and Concepts, Representation of Binary Tree, Binary Tree Traversal (Inorder, Postorder, Preorder), Binary Search Trees
Graph – Representation of Graphs, Elementary Graph Operations (Breadth First Search, Depth First Search, Spanning Trees, Shortest Path, Minimal Spanning Tree).

Module V: (6 Hrs)
Sorting and Searching:
Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Sorting on Several Keys, List and Table Sort, Linear Search, Binary Search.

Module VI: (6 Hrs)
Hashing and Symbol Tables:
Perfect Hashing Functions, Putting Elements, Getting Elements, Testing the Hash Table, Non-string Keys, Growing a Hash Table, Open Addressing.

Text Book:

- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, *"Data Structures and Algorithms in Python"*, Wiley, 2013.

Reference Books:

1. Gowrishankar S, Veena A, *"Introduction to Python Programming"*, 1st Edition, CRC Press/Taylor & Francis, 2019. ISBN-13: 978-0-8153-9437-2.
2. Benjamin Baka, *"Python Data Structures and Algorithms"*, Packt Publishing Ltd., 2017.

Course Code	ECST203				
Category	Programme Core Course				
Course Title	Digital System Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	1	4	III

Course Outcomes
Upon the completion of this course, students will demonstrate the ability to:

1. Realize the digital systems using HDL
2. Apply the testing strategies using HDL
3. Write a synthesizable HDL code for EDA tools
4. Analyze the timing issues in digital systems
5. Implement the digital systems on FPGA platforms

Syllabus

Module I (6 Hrs)
Digital System Design Flow, FPGA Architecture, Introduction to FPGA Development Board, Introduction to HDL, Basic Language Elements, Syntax and Semantics of HDL

Module II (5 Hrs)
Gate level, Dataflow and Behavioral Modeling for combinational circuits like Multiplexer, De-multiplexer, Encoder-Decoder, Flip-Flop, Counter, Writing Test Benches and Handling Text files to test the Circuits

Module III (6 Hrs)
Design and Analysis of Standard Combinational Blocks, Algorithm to Architectural Translation for Arithmetic Circuits – Adders, Subtractor, Multiplier, Divider, Shifter, ALU and Comparator

Module IV (6 Hrs)
Design and analysis of standard sequential blocks, Finite State Machine Design

Module V (6 Hrs)
Design of Data Path and Control Unit with Case Studies

Module VI (6 Hrs)
Logic Synthesis and Optimization Techniques for Area, Power and Delay, Timing analysis – Setup and Hold Violations, Synthesis of HDL Code on FPGA Platforms, Concepts of Critical Path Delay

Text Book:

1. *Verilog HDL: A Guide to Digital Design and Synthesis*; Samir Palnitkar, Prentice Hall PTR; 2nd Edition

2. *Fundamentals of Digital Logic with Verilog*; Stephen Brown and Zvonko Vranesic; McGraw Hill, 2nd Edition

Reference Books:

1. *Digital Systems Design Using Verilog*; Charles Roth, Lizy K. John, ByeongKil Lee; Cengage Learning, 2nd Edition
2. *A Verilog HDL Primer*; J. Bhaskar; Star Galaxy Publishing, 2nd Edition

Course Code	ECST204				
Category	Programme Core Course				
Course Title	Discrete Signals and Systems				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	1	4	III

Course Outcomes

Upon the completion of this course, students will demonstrate the ability to:

1. Classify and find the response of the discrete time systems
2. Analyze the discrete time systems in Z Domain
3. Find the frequency response of signals
4. Design the digital filters
5. Apply signal processing techniques on DSP applications

Syllabus

Module I (6 Hrs)
Elementary continuous & discrete time signals and systems, basic operations on signals, classification of signals and systems, Properties: causality, correlation, stability, step response, impulse response, sampling theorem, aliasing error

Module II (5 Hrs):
Mathematical Overview: Fourier Series, Fourier Transform, Discrete Time Fourier Transform, Laplace Transforms and Z Transform. Relationship of Fourier, Laplace and Z Transform, Region of Convergence and Stability Analysis

Module III (6 Hrs):
Discrete Fourier Transform, Fast Fourier Transform Algorithms (Decimation in Time / Frequency)

Module IV (5 Hrs):
Realization of FIR and IIR System: Direct Form I, Direct Form II, Cascade and Parallel Structures

Module V (8 Hrs):
Filter (FIR & IIR) Design: Fourier Series, Windowing, Frequency Sampling, Butterworth and Chebyshev Techniques

Module VI (5 Hrs):
Practical Case Studies on Image, ECG, EEG, Sound Signal Processing

Text Book:

1. *Digital Signal Processing*, A. Nagoor Kani, 2nd Edition, McGraw Hill

Reference Books:

1. *Digital Signal Processing: Principles, Algorithms & Applications*, Proakis & Manolakis, 4th Edition, PHI
2. *Digital Signal Processing: A Computer-Based Approach*, Mitra S., 4th Edition, McGraw Hill
3. *Discrete Time Signal Processing*, Oppenheim & Schafer, 2nd Edition, PHI

Course Code	MAT277				
Category	Basic Science Course				
Course Title	Linear Algebra				
Scheme Credits	L	T	P	Credits	Semester
	2	0	0	2	III

Course Outcomes

On successful completion of the course, the students will learn:

1. Understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis and linear maps, rank nullity of a matrix / linear map.
2. Apply Gram-Schmidt process on inner product spaces, diagonalize special matrices.
3. Apply concepts of SVD to various applications including real life problems.

Syllabus

Module I (8 Hrs):
Vector Space; Subspaces; Linear Dependence and Independence; Basis; Dimension; Linear transformation; Range Space and Rank; Null Space and Nullity; Rank nullity theorem, Matrix Representation of a linear transformation; Linear Operators on $\mathbb{R}^n$ and their representation as square matrices; Invertible linear operators.

Module II (8 Hrs):
Linear Operators on $\mathbb{R}^n$ and their representation as square matrices; Invertible linear operators. Eigenvalues and Eigenvectors of a linear operator; Inner Product Spaces, Norm; Orthonormal Sets, Gram Schmidt orthogonalization process; projections.

Module III (8 Hrs):
Positive definite matrices, and Singular Value Decomposition. Properties and application of SVD, Least square approximation, QR decomposition.

Text Books:

1. Hoffman and Kunze : *Linear Algebra*, Prentice Hall of India, New Delhi
2. Gilbert Strang : *Linear Algebra And Its Applications (Paperback)*, Nelson Engineering (2007)

Reference Books:

1. Seymour Lipschutz et al: *Linear Algebra*, 3rd ed: Schaum Outline Series
2. V. Krishnamoorthy et al: *An Introduction to Linear Algebra*, Affiliated East West Press, New Delhi
3. P.G. Bhattacharya, S.K. Jain and S.R. Nagpaul : *First Course in Linear Algebra*, Wiley Eastern Ltd., New Delhi
4. K.B. Datta : *Matrix and Linear Algebra*, Prentice Hall of India, New Delhi

Course Code	ECSTH301				
Category	Engineering Science Course				
Course Title	Edge for AI Fundamentals				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	III

Course Outcomes

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

1. Understand the fundamentals of Artificial intelligence and edge computing
2. Apply techniques in edge computing architecture to achieve the best performance of AI training and inference
3. Analyze AI applications on edge under the multiple constraints of networking, communication, computing power, and energy consumption
4. Summarise the principles of Problem solving, quantitative and/or qualitative decision making in complex situations on AI/edge integration applications Syllabus

Syllabus

Module - I: (5 Hours)
Fundamentals of edge computing :
Introduction to edge computing, Trends, Industrial applications, Edge intelligence and intelligent edge

Module - II: (7 Hours)
Paradigms of Edge Computing : Cloudlet and Micro Data Centers, Fog Computing, Mobile and Multi-Access Edge Computing, Edge Computing Terminologies, AI Hardware for Edge Computing, Edge Computing Frameworks, **Virtualizing the Edge**

Module - III: (7 Hours)
AI applications on Edge : Fundamentals of Artificial Intelligence, hybrid hierarchical architecture at three levels: end, edge and cloud; Case studies of Real time video analytics, Autonomous Internet of Vehicles, Intelligent Manufacturing, Smart Home and City.

Module - IV: (7 Hours)
Artificial Intelligence Inference in Edge : Optimization of AI Models in Edge: General methods, Segmentations of AI models, Early Exit of Inference (EEoI) , Sharing of AI Computation

Module - V : (7 Hours)
Artificial Intelligence Training at Edge : Distributed Training at Edge, Vanilla Federated Learning(FL) at Edge, Communication-Efficient FL, Resource-Optimized FL, Security-Enhanced FL Case studies based on training at edge 15

Module - VI: (7 Hours)
Edge Computing for Artificial Intelligence : Edge Hardware for AI, Mobile CPUs and GPUs, TPU(Tensor processing unit) -Based Solutions, Edge Data Analysis for Edge AI Communication and Computation Modes for Edge AI, Tailoring Edge Frameworks for AI, Challenges and Applications

Text Book

1. Edge AI: Convergence of Edge Computing and AI, Xiaofei Wang, Yiwen Han , Victor C. M. Leung, Dusit Niyato , Xueqiang Yan Xu Chen

Reference Book

1. Recent Research Papers from Reputed Journals and Conferences such as DATE, TEST, CVPR, ICLR, NIPS, ICML etc.

Course Code	ECSTM301				
Category	Engineering Science Course				
Course Title	IoT fundamentals				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	III

Course Outcomes

After learning the course, the student will be able to:

1. Understand the basics of networking
2. Gain the knowledge about iot standards
3. Realize the basic applications using arduino and raspberry pi
4. Illustrate different real world applications syllabus

Syllabus

Module - I: (7Hrs)
Basics of Networks, TCP/IP model,IP Addresses, application layer protocols, HTTP, MQTT, WWW, constraint application protocol,stacks.

Module - II: (7Hrs)
Introduction to IoT, evolution of IoT, IoT and SCADA, Big Data, IoT Standards, requirement, Platforms, relevance of IoT, security

Module - III: (7Hrs)
Interoperability in IoT, Machine-to-Machine Communications, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Sensing, Actuation, Sensor Networks

Module - IV: (7Hrs)
Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.

Module - V: (7Hrs)
Introduction to SDN, Fog Computing, IoT application case studies: Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare, Activity Monitoring, IoT in India: Smart India projects, Challenges in IoT

Text Books

1. Computer Networks: A Top-Down Approach; Behrouz A Forouzan, Firouz Mosharraf, McGraw Hill Education. Special Indian Edition 2012
2. Arduino Cookbookby Michael Margolis, O'Reilly Media, Inc., 1st edition
3. Raspberry pi Cookbook by Simon Monk, O'Reilly Media, Inc., 3rd edition.

Syllabus of Semester IV B.Tech.

Department of Electronics and Computer Science

Course Code	ECST206				
Category	Programme Core Course				
Course Title	Discrete Mathematics				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	IV

Course Outcomes

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

1. Internalize logical notations to define fundamental mathematical concepts to derive logical inference and solve problems related to recurrence relations, linear congruences, coding theory, etc. in cryptography.
2. Understand a given problem of graph network and solve with techniques of graph theory.
3. Realize the lattice as algebraic structure and use it for pattern recognition in cryptography.
4. Apply groups and fields in coding theory.

Syllabus

Module I – Mathematical Logic (6 Hrs)
Statement and notations, connectives, Negation, conjunction, disjunction, conditional & bi-conditional, statement formulas & truth tables. Tautologies, equivalence of formulas, Duality law, Tautological implications.

Module II – Modular Arithmetic (6 Hrs)
Modular Arithmetic, Euclid's Algorithm, Primes, Fermat's Algorithm, Euler's Theorem, Diophantine equations, Linear Congruences, Chinese Remainder Theorem, Application to Cryptography.

Module III – Graph Theory (6 Hrs)
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub-Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Perfect Graph.

Module IV – Combinatorics (6 Hrs)
Addition and multiplication rules in combinatorics, Linear and circular permutation, Combination, Inclusion and Exclusion Principle, recurrence relations, generating function, examples using ordinary power series and exponential generating functions.

Module V – Lattice Theory (6 Hrs)
Lattices as partially ordered set, Definitions and Examples, some properties of Lattices, Lattices as algebraic system, sub lattices, direct product, homomorphism, some special Lattices.

Module VI – Groups and Fields (6 Hrs)
Group definitions and examples, cyclic group, permutation groups, subgroups and homomorphism, co-sets, Lagrange's theorem, Finite field, Galois field.

Text Books

1. J. P. Tremblay and R. Manohar; *Discrete Mathematical Structures with Applications to Computer Science*; Tata McGraw-Hill Publication.
2. Babu Ram; *Discrete Mathematics*; Pearson Education.
3. C. L. Liu and D. P. Mohapatra; *Combinatorial Mathematics*, 3rd Edition, Tata McGraw-Hill.

Reference Books

1. Kenneth H. Rosen; *Discrete Mathematics and its Applications*, 8th Edition, Tata McGraw-Hill.
2. Susanna S. Epp; *Discrete Mathematics with Applications*, 4th Edition, Wadsworth Publishing Co. Inc.
3. C. L. Liu and D. P. Mohapatra; *Elements of Discrete Mathematics: A Computer Oriented Approach*, 3rd Edition, Tata McGraw-Hill.

Course Code	ECST207				
Category	Programme Core Course				
Course Title	Software Engineering				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	IV

Course Outcomes

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

1. Understand generic processes of software development and learn different techniques and methodologies used in development of software systems.
2. Apply learned concepts to effectively use software testing methodologies in various software development scenarios.
3. Develop comprehensive plans for resource allocation and project monitoring and apply quality management techniques to ensure process and product quality in software development.

Syllabus

Module I
Introduction to Software Engineering, Exploratory style versus Software Engineering, Shortcoming of exploratory style, Basic principles to handle complexity, Some basic issues: Types of software projects, software services, Emergence of software engineering principles, Evolution of design techniques.

Module II
Software Process Models, Basic concepts of classical Waterfall Model, Stages of Waterfall Model, Iterative Waterfall Model, V-Model and Prototyping Model, Incremental Model, Evolutionary Model, Agile Model, Extreme Programming and Scrum, Scrum Life Cycle Model, Case Study on software development life cycle (SDLC)

Module III
Basic testing concepts, levels of testing, Errors, Faults and Failure, Unit, Integration and System Testing, Test data, Test cases, and Test Suite, Pesticide effect, Validation Testing, System Testing, Debugging. Software Testing fundamentals, Black Box Testing, White Box Testing, Web Testing, Test case design, building, execution, Automated Testing. Path Testing, Case Study on Software Testing Life Cycle (STLC)

Module IV
Software Project management – Plans, Methods and Methodology, The Business Case, Project Success and Failure, Project Evaluation, Cost-benefit evaluation technique, Project Planning – stepwise project Planning, Software Effort Estimation – Albrecht Function Point Analysis, COSMIC Function Point, Cost Estimation, Project Scheduling.

Module V
Resource allocation: Introduction, Nature of Resources, Identifying Resource Requirement,

scheduling Resources, Project Monitoring and Control, Project Control Cycle, Configuration Management, Process, Configuration Management Tool, Project Management Tools. Contract Management: Managing Contracts, Types of Contracts, stages in contract placement, contract checklist. Project Close out, Reasons of Project Closure, Project Closure process and report.

Module VI
Software Quality Management: Introduction to Software Quality, Evolution of quality systems, Quality Control, Quality Assurance, Total Quality Management, Process Improvement, Process and Product Quality, CMM (Capability Maturity Model), Personal Software Process (PSP), Software Reliability, Software Testing, Risk management.

Text Books

1. *Software Engineering – A Practitioner's Approach*; Roger Pressman; Sixth Edition, McGraw Hill, 2010
2. *Project Management* by Clifford F. Gray, Erik W. Larson, McGraw Hill

Reference Books

1. *Software Engineering*; Ian Somerville; Seventh Edition; Pearson Education, 2008
2. *Ethics in Information Technology*; George W. Reynolds, 4th Edition, Cengage Learning Publication
3. *Software Engineering*; David Gustafson, Schaum's Series, Tata McGraw Hill, 2002
4. *Software Project Management*; Sanjay Mohapatra; First Edition, Cengage Learning, 2011
5. *Software Project Management*; Rajib Mall, 5th Edition, McGraw Hill

Course Code	ECSP207				
Category	Programme Core Course				
Course Title	Software Engineering Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	IV

Experiment List

[1]
a. Explore the perspectives and notations of the Unified Modeling Language (UML) in Star UML.
b. Study the IEEE SRS standard and prepare SRS for the conceptualization of the identified systems.

[2]
Create a Use-Case diagram to depict the user's perspective of the system, demonstrating user interactions and system functionalities.

[3]
Develop a Class Diagram to articulate the structural aspects of the system.

[4]
Construct Component Diagram and Deployment Diagram to depict the structural view of the system.

[5]
Construct a Sequence Diagram to represent the dynamic view or behavior of the system, illustrating the chronological flow of interactions among different components or entities within the system.

[6]
Create an Activity Diagram and a Statechart Diagram to illustrate the system's behavioural perspective.

[7]
Perform White-Box Testing to test the functionalities using JUnit testing tool.

[8]
Mini Project: Based on real-time modeling of software on a testbed and in a production environment, with case studies on SDLC and STLC.

Course Code	ECST208				
Category	Programme Core Course				
Course Title	Computer Architecture and Organization				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	IV

Course Outcomes

Upon completion of this course, students will demonstrate the ability to:

1. Understand common principles of computer organization and multiprocessing
2. Apply the concept of cache and virtual memory management in computer system
3. Analyse different arithmetic algorithms, control unit and processor datapath with and without pipelining
4. Use Field Programmable Gate Arrays for investigating algorithms, datapath, I/O and memory for computing system

Syllabus

Module I
Introduction to computer system and its sub modules, Introduction to RISC and CISC paradigm, Performance Equation, Common Principles of Computer organization: Amdahl's Law, Principle of Locality.

Module II
Processor organization, instruction set (MIPS), instruction formats, Arithmetic for Computers: Addition and Subtraction, Multiplication, Division, IEEE 754 floating point format.

Module III
Processor Design-Introduction, Datapath and control unit design, Performance Considerations, Multi-cycle design, Micro Programmed control design, Exception Handling.

Module IV
Motivation for Pipelining, Clock period and CPI, Pipelined data path, graphical representation, Pipelining Hazards.

Module V
Memory organization, concepts of semiconductor memory, memory management, concept of cache and associative memories, virtual memory.

Module VI
Parallel processing concepts, multiprocessors and its characteristics, Input/Output Subsystem:- Interfaces and BUS, I/O Operations, Designing I/O Systems, Case study: Application of RISC and CISC as Data Centers perspective.

Text Books

1. *Computer Organization and Design - The Hardware/Software Interface*, David A. Patterson, John L. Hennessy, Fifth Edition, 2014.

Reference Books

1. *Computer Architecture and Organization*; J. P. Hayes; Third Edition (Fifth Reprint), McGraw Hill, 2012.
2. *Computer Architecture And Parallel Processing*; Kai Hawang, Faye A. Briggs, McGraw Hill, 2012.
3. *Computer Organization*; Safwat G. Zaky, Zvonko G. Vranesic, Carl Hammacher; Fifth Edition, McGraw Hill, 2002.
4. *Structured Computer Organization*; Andrew S. Tanenbaum; Fifth Edition, Pearson, 2005.

Course Code	ECST209				
Category	Programme Core Course				
Course Title	Embedded System Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	IV

Course Outcomes

1. Understand the architecture and organization of Cortex microcontroller and its programming.
2. Acquire the knowledge, techniques and skill to integrate microcontroller hardware and software.
3. Analyse the concept of real time operating system architecture.
4. Apply microcontroller-based Embedded system knowledge to real world application.

Syllabus

Module I
Introduction to embedded System, RISC Principles, ARM Processor Families, AMBA Bus Architecture.

Module II
The Cortex - M processor: Simplified view block diagram, programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence, Instruction Set, Pipeline, Bus, Priority, Vector Tables, Interrupt Inputs and Pending behavior, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller.

Module III
Introduction to the Cortex microcontroller software interface standard (CMSIS), Interfacing of GPIOs, Timers, ADC, PWM.

Module IV
Communication Protocols: I2C, SPI, UART, MODBUS, USB and its Interfacing with Cortex - M Microcontrollers.

Module V
RTOS Concepts - Critical section, Shared Resources, Context Switching, Pre-emptive and non-pre-emptive Schedulers, Priority Inversion, Mutual exclusion, Synchronization, Inter task communication mechanisms.

Module VI
Structure of µCOS-II: Introduction to µCOS-II, kernel structure, Task States, Inter task communication, Task Scheduling, Task Synchronization, Critical section, Shared Resources, Context Switching, Priority Inversion, Mutual exclusion. Introduction to embedded Linux.

Text Books

1. *The Definitive Guide to the ARM Cortex-M0*, Joseph Yiu, Elsevier, (1st Edition) 2011.

Reference Books

1. *Freescale ARM Cortex-M Embedded Programming*, Mazidi and Naimi
2. *An Embedded Software Primer*, David E. Simon, Pearson Education Asia, 2001
3. *Micro C/OS II – The Real Time Kernel*, Jean J. Labrosse, CMP Books, (2nd Edition) 2002
4. *Embedded Linux Primer*, Christopher Hallinan, Pearson (1st Edition) 2007

Course Code	ECSP210				
Category	Programme Core Course				
Course Title	Hardware System Design Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	IV

Experiment List

1. Familiarization with BUS Structure and debugging tool for the CPU
2. Test the instruction memory and data Memory of a Single Cycle CPU on the FPGA board.
3. Test the register files of a Single Cycle CPU on the FPGA board.
4. Test the ALU operations of a Single Cycle CPU on the FPGA board.
5. Test the data & control path of a Single cycle CPU on the FPGA board.
6. Create Fibonacci Series and write an assembly language program.
7. Sort the numbers in descending order using assembly language program.
8. Implement the given equation using assembly language program.
9. Interfacing of Switch and LEDs with Cortex M0 processor using GPIO pins.
10. Interfacing of LCD with Cortex M0 processor for displaying key status on LCD.

Course Code	ECSP211				
Category	Engineering Core Course				
Course Title	Software Lab-I				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	IV

Course Outcomes

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

1. Understand Processes, Tools, and Methodologies in Software Development Lifecycle.
2. Implement Agile Software Development Life Cycle.
3. Integrate Software Development and its Operations.
4. Use Cloud Environment and its Services.

Syllabus

Labs Based on following Course Contents

1. Introduction to DevOps.
2. Version Control System (Git and GitHub).
3. Integration, Deployment and Building (Jenkins).
4. Resource Management and Configuration (Puppet and Chef).
5. Containerization (Docker).
6. Working with Nagios Monitoring Tool.
7. Cloud services and DevOps.

Reference Books

1. *The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations* by Gene Kim, Patrick Debois, John Willis, Jez Humble, 2016.
2. *Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale* by Jennifer Davis.
3. *Python for DevOps: Learn Ruthlessly Effective Automation* by Noah Gift, Kennedy Behrman, Alfredo Deza, Grig Gheorghiu.
4. *Building Microservices: Designing Fine-Grained Systems* by Sam Newman.
5. *Effective DevOps with AWS: Ship faster, scale better, and deliver incredible productivity* by Nathaniel Felsen.

Course Code	ECST212				
Category	Engineering Science Course				
Course Title	Statistics for Data Analytics				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	IV

Course Outcomes

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

1. Apply statistical techniques effectively to solve complex problems in the context of data analytics.
2. Apply data cleaning, visualization, and feature engineering for effective exploratory data analysis.
3. Formulate and test hypotheses, construct confidence intervals, and apply statistical inference techniques.
4. Apply statistical inference techniques, queuing theory principles and analyze the structure and behavior of queuing systems.
5. Apply predictive modeling in data analytics through case studies and real-world applications

Syllabus

Module 1: Foundations of Statistics (6 Hrs)
Introduction to Descriptive and Inferential Statistics, Measures of Central Tendency and Dispersion, Data Visualization Techniques

Module 2: Distributions and Probability Theory (6 Hrs)
Probability theory and Probability Distributions, Sampling and Sampling Distributions

Module 3: Exploratory Data Analysis (EDA) (7 Hrs)
Data Cleaning and Preprocessing, Exploratory Data Visualization, Outlier Detection and Handling, Correlation and Covariance Analysis, Feature Engineering Basics (with R Programming)

Module 4: Statistical Inference (7 Hrs)
Hypothesis Testing (Parametric and Non-Parametric), Confidence Intervals, Analysis of Variance (ANOVA), Chi-Square Tests, Power Analysis and Sample Size Determination

Module 5: Queuing Theory (6 Hrs)
Structure of a queuing system – Operating characteristics of queuing system – Transient and steady states – Terminology of queuing systems – Arrival and service processes – Pure Birth-Death process Deterministic queuing models – M/M/1 Model of infinite queue – M/M/1 model of finite queue.

Module 6: Advanced Topics in Statistics for Data Analytics (4 Hrs)
Predictive modeling in Data analytics, Case Studies and Real-world Applications

Text Books

1. Gupta.S.C. and Kapoor.V.K. (2014): Fundamentals of Applied Statistics , Sultan Chand and sons. 2.
2. Agarwal.B.L (2007): Basic statistics, 3/e, New Age International (P) Ltd

Reference Books

1. Practical Statistics for Data Scientists –Peter Bruce and Andrew Bruce, O'Reilly Media, Inc.
2. Mood, A. M., Graybill, F. A. And Boes, D.C.: Introduction to the Theory of Statistics, McGraw Hill.
3. "An Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer

Course Code	ECST299-1				
Category	Open Elective				
Course Title	Linux for Beginners				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	IV

Course Outcomes

1. Acquire a working knowledge of Linux fundamentals and Linux distributions.
2. Apply knowledge to comprehend system configurations and Linux graphical interfaces.
3. Independently perform fundamental command line operations in Linux.
4. Effectively employ common Linux applications for specific tasks and functionalities.

Syllabus

Module I
The Linux Foundation: Linux Philosophy and Concepts, Linux Basics and System Startup.

Module II
Graphical Interface, System Configuration from the Graphical Interface, Common Applications, Command Line Operations, Finding Linux Documentation.

Module III
Processes, File Operations, Text Editors, User Environment, Manipulating Text, Network Operations.

Module IV
The Bash Shell and bash Scripting, Introduction, Features and Capabilities, Syntax, Constructs.

Module V
Printing, Local Security Principles, Understanding Linux Security, root Privileges, sudo, Process Isolation, Limiting Hardware Access and Keeping Systems Current, Working with Passwords, Securing the Boot Process and Hardware Resources.

Module VI
Remote access and managing processes through remote login.

Text Books

1. *Linux BIBLE*, Christopher Negus, Tenth Edition, Wiley, 2020.
2. *Linux for Beginners: An Introduction to the Linux Operating System and Command Line*, Jason Cannon, O'Reilly, 2014.

Course Code	ECSTH401				
Category	Programme Core Course				
Course Title	Embedded Machine Learning				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	IV

Course Outcomes

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

1. Understand the key design considerations for efficient DNN processing.
2. Understand tradeoffs between various hardware architectures and platforms.
3. Develop and analyze the architecture of DNN accelerators using software framework.
4. Review the performance using case studies.

Syllabus

Module I
Introduction to Machine Learning, background, overview and its limitations, Machine Learning on embedded systems and computer interfaces.

Module II
Background and overview on Deep Neural Networks, Training versus Inference, Applications of DNNs, Key Metrics: Accuracy, Throughput and Latency, Energy Efficiency and Power Consumption, Hardware Cost, Flexibility, Scalability, Interplay Between Different Metrics.

Module II (continued)
Introduction to processors included in detail. Processors – Graphics Processing Unit (GPU), Central Processing Unit (CPU), Neural Processing Unit (NPU), Embedded AI devices, Embedded versus Cloud.

Module III
Introduction to Software Framework: PyTorch, TinyML.

Module IV
Operation mapping on specialized hardware, Audio classification on embedded systems, Precision reduction, Quantization, Sparsity.

Module V
Case Study: Real world machine learning application and implementation.

Text Book

1. *Efficient Processing of Deep Neural Networks*, Vivienne Sze, Yu-Hsin Chen, Tien-Ju Yang, and Joel S. Emer, Morgan & Claypool Publishers (2020).
2. *Practical Deep Learning for Cloud, Mobile and Edge: Real-World AI & Computer-Vision Projects Using Python, Keras & Tensorflow*, Anirudh Koul, Siddha Ganju, Meher Kasam, O'Reilly; Illustrated edition (2019).

Reference Books

1. *IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security*, 2nd Edition, Perry Lea, Packt Publishing Limited.
2. *Hardware Architectures for Deep Learning*, Masoud Daneshtalab, Mehdi Modarressi, Institution of Engineering and Technology.
3. Recent research papers from reputed journals and conferences such as CVPR, ICLR, NIPS, ICML, PAMI, etc.

Course Code	ECSTM401				
Category	Programme Core Course				
Course Title	Sensor Interfacing with Arduino and ESP8266				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	IV

Course Outcomes

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

1. Code in Arduino IDE that works with open source hardware platforms like Arduino and ESP.
2. Measure physical parameters using sensors and control various actuators.
3. Interface devices with serial communication protocols.

Syllabus

Module I
Introduction to Arduino Prototyping Platform: Arduino IDE, Arduino C, setting up the Arduino board, creating sketches, using libraries, using example codes, debugging using the Serial Monitor.

Module II
Sensor interfacing with Arduino: analog and digital sensors, temperature sensors, humidity sensors, proximity sensors, ultrasonic sensor, accelerometer and gyro, etc.

Module III
Serial Communication in Arduino: serial and parallel communication, serial communication protocols, UART, I2C, SPI, wired and wireless communication, interfacing communication modules with Arduino.

Module IV
Interfacing Displays and Actuators: 16x2 LCD, graphical LCD, graphical OLED, relay, speed and direction control of DC, servo and stepper motor.

Module V
Introduction to ESP8266: ESP8266 development board, programming ESP8266 through Arduino IDE, connecting to the internet, sending and receiving data on internet.

Module VI
Interfacing sensors and actuators with ESP8266: LDR, temperature sensor, humidity sensor, RGB LED, relay, etc.

Text Books

1. *Arduino Cookbook* by Michael Margolis, O'Reilly Media, Inc., 1st edition.
2. *Beginning C for Arduino* by Jack Purdum (ebook).
3. *Arduino for Beginners: Essential Skills Every Maker Needs* by John Baichtal, Pearson Education, Inc., 1st edition.

Syllabus of Semester V B.Tech.

Department of Electronics and Computer Science

Course Code	ECST301				
Category	Programme Core Course				
Course Title	Operating System				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

Course Outcomes

On successful completion of the course, the student will be able to:

1. Understand the fundamental concepts and functions of operating systems.
2. Analyze process management, scheduling algorithms, and thread synchronization techniques.
3. Evaluate memory management strategies, including virtual memory and memory protection.
4. Implement file systems, disk scheduling algorithms, and device management techniques.
5. Students will gain proficiency in Linux system administration tasks, including booting Linux on hardware platforms, kernel administration, device management, and networking, with a focus on practical applications using the Raspberry Pi platform.

Syllabus

Module I: Introduction to Operating Systems
Overview of operating systems, Role and functions of operating systems, Types of operating systems, Historical perspective, Operating system structure and components.

Module II: Process Management, Scheduling Algorithms, Process Synchronization, Threads and Deadlocks
Process concept and management, Process states and transitions, Process scheduling algorithms, CPU scheduling, Process synchronization and concurrency, Inter-process communication, Deadlock detection and prevention, Resource allocation and management, Multiprogramming and multitasking.

Module III: Memory Management
Memory hierarchy, Memory allocation strategies, Virtual memory concept, Paging and segmentation, Memory protection and addressing, Memory management unit (MMU).

Module IV: File Systems and I/O Management
File system organization and structure, File system implementation techniques, File system operations, Disk scheduling algorithms, Device management and drivers, Input/output operations and buffering.

Module V: System Security
Basics of system security, Access control and authentication, Threats and vulnerabilities, Security mechanisms and policies.

Text Books

1. Operating Systems: Internals and Design Principles, William Stallings, Pearson Education, 9th edition, 2018
2. Operating Systems Foundations with Linux on the Raspberry Pi, Jeremy Singer and Wim Vanderbauwhede, ARM Education Media, 2019

Reference Books

1. Linux System Programming: Talking Directly to the Kernel and C Library, Robert Love, O'Reilly Media, 2nd edition, 2013
2. Operating Systems Design and Implementation, Andrew S. Tanenbaum and Albert S. Woodhull, PHI, 3rd edition, 2003
3. Operating Systems: Three Easy Pieces, Remzi Arpaci-Dusseau, Andrea Arpaci-Dusseau, Arpaci-Dusseau Books, 2023

Course Code	ECSP301				
Category	Programme Core Course				
Course Title	Operating System Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

List of Experiments

1. Study of Linux commands including system information, files and directories, process management, text processing and scripting, and programming.
2. Shell scripting focusing on input/output handling, decision making, and looping constructs.
3. Installing Raspbian on Raspberry Pi 3, setting up SSH under Raspbian, and writing a kernel module.
4. Create a cyclic executive with three tasks where each task creates a continuous waveform: task 1 creates a sine wave, task 2 a block wave, and task 3 a triangle wave, each with different periods. Print either the values of the waveforms or a text-based graph on the terminal. Make your cyclic executive preemptive. Share a resource between the three tasks, such as a simple shared variable with read and write access.
5. Create a round-robin scheduler and a FIFO scheduler.
6. Calculate the size of your Raspberry Pi system's virtual address space in megabytes by writing a short C program.
7. Implement a solution to the dining philosophers problem in C using the POSIX threads API.
8. Create a system of N threads that communicate via static arrays of size N defined in each thread, using condition variables and mutexes.
9. Write a data-parallel program that produces the sum of the squares of all values in an array, using p threads and OpenMP.

Course Code	ECST302				
Category	Programme Core Course				
Course Title	Design and Analysis of Algorithms				
Scheme & Credits	L	T	P	Credits	Semester
	4	0	0	4	V

Course Outcomes

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

1. Understand mathematical formulations, complexity analysis, and methodologies to solve recurrence relations in algorithms.
2. Apply the Divide and Conquer paradigm to solve standard algorithmic problems.
3. Formulate Greedy Methodologies and apply them to real-life optimization problems.
4. Design solutions using Dynamic Programming and Backtracking techniques for complex problems.
5. Develop algorithmic solutions while understanding NP-class problems and apply standard approaches to handle them.

Syllabus

Module I: Mathematical Foundations & Complexity Analysis (Hours: 7)
Covers arithmetic and geometric series, principles of algorithm design, time and space complexity analysis using asymptotic notations such as Big-O, Big-Ω, and Big-Θ. Includes worst-case, average-case, and amortized analysis, and solving recurrence relations.

Module II: Divide and Conquer (Hours: 7)
Introduces the divide and conquer paradigm through examples such as Quick Sort, Merge Sort, Strassen's matrix multiplication. Also includes problems like maximum sub-array, closest pair of points, and convex hull.

Module III: Greedy Method (Hours: 7)
Explores greedy strategy through problems such as the fractional knapsack, minimum cost spanning trees (Prim's and Kruskal's), Huffman coding, and activity selection. Also includes advanced examples like the maximum sum from three stacks and the K-Centers problem.

Module IV: Dynamic Programming (Hours: 7)
Introduces dynamic programming as a problem-solving approach through algorithms like Bellman-Ford and Floyd-Warshall (all-pairs shortest path), multistage graphs, optimal binary search trees, traveling salesman problem, string editing, and longest common subsequence and its variations.

Module V: Backtracking and Search Techniques (Hours: 7)
Covers basic graph traversal techniques such as breadth-first and depth-first search, and identification of connected components. Introduces the backtracking paradigm with problems like the 8-Queen's problem and subset sum problem. Also introduces approximation algorithms.

Module VI: NP-Completeness and Intractability (Hours: 7)
Focuses on NP-Hard and NP-Complete problems, non-deterministic algorithms, and polynomial reduction techniques. Discusses decision and optimization problems and graph-based NP problems including vertex cover and clique cover.

Textbooks

1. Thomas H. Cormen et al., Introduction to Algorithms, 3rd Edition, Prentice Hall, 2009.
2. Horowitz, Sahni, and Rajasekaran, Computer Algorithms, Silicon Press, 2008.
3. Brassard and Bratley, Fundamentals of Algorithms, 1st Edition, Prentice Hall, 1995.
4. Richard Johnsonbaugh, Algorithms, Pearson Publication, 2003.

Reference Books

1. Parag Himanshu Dave, Balchandra Dave, Design and Analysis of Algorithms, Pearson Education, O'Reilly Publication.
2. Richard Johnsonbaugh, Algorithms, Pearson Publication, 2003.

Course Code	ECST303				
Category	Programme Core Course				
Course Title	Machine Learning				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

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

1. Compare and contrast different paradigms of machine-learning techniques and to get an insight of when to apply a particular machine learning approach.
2. Integrate multiple facets of practical machine learning in a single system: data preprocessing, learning, regularization and model selection.
3. Employ probability theory, calculus, linear algebra, and optimization in order to develop predictive models or learning methods.
4. Implement and analyze existing learning algorithms, including well-studied methods for classification, regression, and clustering and test them with benchmark data sets.
5. Evaluate and interpret the results of the machine-learning algorithms.

Syllabus

Module I: (4 Hrs)
Foundations for ML: Review of Linear algebra and Optimization, introduction to machine learning and its types, parametric vs non-parametric models, machine Learning pipeline and MLOPs.

Module II: (7 Hrs)
Supervised learning algorithms: Linear and Logistic Regression – Bias/Variance Trade-off, overfitting and under fitting, Regularization, Multivariate and polynomial Regression, Variants of Gradient Descent algorithm. Decision Trees, Basic decision trees learning algorithm, Random Forests.

Module III: (7 Hrs)
Support Vector Machines, and Kernel functions in SVM, K-Nearest Neighbors. Feature selection techniques: Filter Method, Wrapper Method, Feature scaling, Evaluation and Model Selection: ROC and AUC Curves, Evaluation Measures, Cross-Validation techniques.

Module IV: (5 Hrs)
Probabilistic Machine Learning: Bayesian learning and Bayesian networks, Naive Bayes classifier; Bayes optimal classifiers, Maximum Likelihood Estimation, MAP; Gaussian Discriminant Analysis.

Module V: (6 Hrs)
Unsupervised learning algorithms: K-means clustering, Hierarchical Clustering, Dimensionality Reduction techniques: PCA, LDA.

Module VI: (6 Hrs)
Unsupervised learning algorithms: Hidden Markov Models, Gaussian Mixture Modeling, EM-algorithms, Anomaly detection, Recommender System.

Text Book:

1. Machine learning, by Mitchell Tom, First edition, McGraw Hill, 1997.
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, First edition, Springer, 2006.

Reference Books:

1. The Elements of Statistical Learning Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Second Edition, Springer, 2009.
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, Francis Bach; MIT Press, 2012.
3. Understanding Machine Learning: From Theory to Algorithms by Shai Shale-Shwartz, and Shai Ben-David, Cambridge University Press, 2014.

Course Code	ECSP303				
Category	Programme Core Course				
Course Title	Machine Learning Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

List of Experiments:

Lab-01: Implement data preprocessing techniques on the given dataset.
a) Perform Exploratory Data Analysis (EDA)
b) Decide on strategies for handling missing data (e.g., imputation, deletion, interpolation)
c) Identify and remove duplicate entries from the dataset if any
d) Detect outliers and decide on appropriate treatment methods (e.g., removal, transformation, binning)
e) Convert categorical variables into numerical representations suitable for machine learning algorithms (e.g., one-hot encoding, label encoding, target encoding)
f) Standardize or normalize numerical features to ensure they have a similar scale, preventing certain features from dominating the learning process
g) Create new features from existing ones or transform existing features to improve model performance (e.g., polynomial features, interaction terms, domain-specific transformations)
h) Use techniques like filter methods (e.g., correlation analysis), wrapper methods (e.g., recursive feature elimination) for feature selection
i) Divide the dataset into training and testing sets to evaluate the performance of the machine-learning model
j) Visualize the dataset to gain insights into its distribution, relationships between features, and potential patterns
k) Explore summary statistics, histograms, scatter plots, and correlation matrices to understand the data's characteristics and inform preprocessing decisions

Lab-02: Implement linear regression algorithm (Single, Multiple variable and polynomial) using benchmark datasets and evaluate the performance of linear regression using evaluation measures like MAE, MSE, RMSE, Coefficient of Determination (R^2), and Adjusted R-squared.

Lab-03: Implement the following algorithms to perform the task of classification on the benchmark datasets and evaluate the performance of algorithms using evaluation measures like Accuracy, Precision, Recall, F1 score, ROC curves, AUC, and cross-validation techniques:
a) Logistic Regression
b) Decision Tree
c) Random Forest
d) K-nearest Neighbor

Lab-04: Build and implement an image classifier using Support Vector Machine (SVM) algorithm and evaluate the performance of the trained model using k-fold cross-validation.

Lab-05: Build and develop a model for document classification using probabilistic machine learning algorithms.

Lab-06: Implement the K-means clustering algorithm to perform image segmentation and compare its performance with different numbers of clusters (k) using various evaluation metrics such as silhouette score, Davies-Bouldin index, and within-cluster sum of squares (WCSS).

Lab-07: Perform Dimensionality Reduction using Principal Components Analysis (PCA) and do the following tasks:
a) Use PCA to visualize a high-dimensional problem in 2-dimensions
b) Use PCA to improve model-training time and understand the speed-accuracy trade-off
c) Evaluate the trade-offs between preserving global structure and local relationships in the data space
d) Discuss when to use PCA and when not to use it

Lab-08: Implement Gaussian Mixture Model (GMM) Clustering to model complex data distributions and visualize the resulting cluster assignments and probability contours.

Lab-09: Investigate the effectiveness of Isolation Forest for identifying outliers and detecting anomalous behavior in server computers.

Lab-10: Build a simple recommender system using collaborative filtering or matrix factorization techniques and assess its performance using metrics like Mean Absolute Error (MAE) or Root Mean Squared Error (RMSE).

Lab-11: Perform the comparative analysis of ensemble learning techniques on classification tasks.

Lab-12: A Capstone Project: Students are required to utilize the knowledge and competencies gained throughout the course to address a practical real-world challenge or investigate a substantial research query within the realm of machine learning.

Course Code	ECSP304				
Category	Engineering Core Course				
Course Title	Software Lab – 2				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

Course Outcomes

On successful completion of the course, the student will be able to:

1. Understand syntax commands and deployment using Jenkins.
2. Implement automation using Ansible.
3. Understand Kubernetes and deployment using Docker.
4. Understand continuous monitoring tools using Nagios and Portainer.
5. Use cloud environment and its services.

Syllabus

List of Experiments

1. **Jenkins**
   i. Introduction to Jenkins
   ii. Setup and installation of Jenkins
   iii. Jenkins syntaxes and commands
   iv. Basic example
   v. Integration, deployment and building
2. **Ansible**
   i. Introduction to Ansible
   ii. Exploring Ansible concepts
   iii. Automating with Ansible
   iv. Creating playbook and building inventory
3. **Kubernetes**
   i. Install and configure Kubernetes
   ii. Run stateless and stateful applications on Kubernetes
   iii. Install and use Kubeless to run functions (Serverless) on Kubernetes
   iv. Use Docker Client (with Kubernetes)
4. **Nagios Monitoring Tool**
   Continuous Monitoring with Nagios
5. **GitLab and Bitbucket**
   Repository Management, features and integrations
6. **Working with Portainer**
   Container management across cloud, data center, network edge, and Industrial IoT devices
7. **Cloud Services and DevOps**
8. **Mini Project**

Reference Books

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations by Gene Kim, Patrick Debois, John Willis, Jez Humble, 2016
2. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis
3. Python for DevOps: Learn Ruthlessly Effective Automation by Noah Gift, Kennedy Behrman, Alfredo Deza, Grig Gheorghiu
4. Building Microservices: Designing Fine-Grained Systems by Sam Newman
5. Effective DevOps with AWS: Ship Faster, Scale Better, and Deliver Incredible Productivity by Nathaniel Felsen

Course Code	ECST305-1				
Category	Programme Elective Course				
Course Title	SOC Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

Course Outcomes:

After completion of the course student will be able to:

1. Understand the fundamentals of SoC architecture and organization
2. Apply the knowledge of processor microarchitectures and design trade - off for SoC Design.
3. Examine the on-chip and off-chip memories for SoC Design
4. Evaluate on-chip interconnects structure for different topologies.
5. Apply concepts of NoC design for architecture, topologies and router design
6. Examine MPSoC using various design metrics.

Syllabus

Module - I: (6 Hrs)

Introduction to the Systems Approach : System Architecture: An Overview, Hardware and Software: Programmability Versus Performance, Product Economics and Implications for SoC, Dealing with Design Complexity, Chip Basics: Time, Area, Power, Reliability and Configurability

Module - II: (6 Hrs)

Processors: Processor Selection for SoC, Basic concepts in Processor Micro Architecture, Instruction handling. Buffers, Branches, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Module - III: (6 Hrs)

Memory Design: Overview of SoC external memory and Internal Memory, Memory Technology: Off-Chip Memories, Embedded Memories, Cache memory, Virtual Memory , SoC Memory System, Models of Simple Processor – memory interaction.

Module - IV: (6 Hrs)

Interconnect: Overview: Interconnect Architectures, Bus: SoC Standard Buses, AMBA, Core Connect, Interface Units: Bus Sockets and Bus Wrappers

Module - V: (5 Hrs)

Network on Chip: Architecture, Topologies, Switching strategies, Routing Algorithm, flow control techniques, Router Microarchitecture, Layered Architecture and Network Interface Unit, Performance Metrics

Module - VI: (7 Hrs)
Requirements and Concepts of Embedded MPSoCs, MPSoC Design Techniques: Performance and Flexibility Considerations, AI and Machine Learning in SoCs

Text Book

Computer System Design: System-On-Chip : Michael J. Flynn,Wayne Luk, Wiley India 2012

Reference Books

1. Computer Architecture: A Quantitative Approach: John L. Hennessy, David A. Patterson, Morgan Kaufman 2012
2. Memory System: Cache, DRAM and Disk, Bruce Jacob, Spencer W. Ng, David T. Wang, Morgan Kaufman 2008
3. Principles and Practices of Interconnection Networks, William J. Dally, Brian P. Towles, Elsevier 2004 4. ARM System-on-Chip Architecture, Steve Furber, Addison Wesley 2000 5. ARM University Program "System-on-Chip" Module

Course Code	ECST305-2				
Category	Programme Elective Course				
Course Title	Elements of IoT				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

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

1. Understand the IoT reference model and different elements used in it.
2. Apply the understanding in identifying the elements used in IoT.
3. Analyse the role of different elements in IoT as a system in different use cases.
4. Propose a solution to a real-world problem using the IoT framework.
5. Evaluate the engineering feasibility of the solutions/use cases.

Syllabus

Module I [6 Hrs]
Introduction to Internet of Everything, IoT Reference Model, Different IoT models, Elements in IoT Infrastructure

Module II [6 Hrs]
IoT Infrastructure Elements and their roles at Different Layers in IoT Reference Model, Devices/Function of elements in IoT: Sensors, Controllers, Network, Cloud, User Applications and Data Analytics

Module III [6 Hrs]
Perception Layer, Network Layer, Application Layer Architecture in IoT system

Module IV [6 Hrs]
Resources used at Perception Layer, Network Layer, Application Layer

Module V [6 Hrs]
Use cases of IoT Systems built across SAMIoT / Arduino / ESP32 / NodeMCU / PI-PICO H/W variants

Text Book

1. Internet of Things: Principles and Paradigms, Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufman, Elsevier, 2016, 1st Edition

Reference Books

1. Internet of Things: Principles, Paradigms and Application of IoT, Joseph Kofi Wireko, Kaml Hiran, BPB Publications, 2020, 1st Edition
2. Microchip SAMIoT Application Notes
3. Arduino Nano BLE / Nano 33 IoT Application Notes
4. Espressif Application Notes: ESP32 / ESP8266 / NodeMCU
5. Raspberry Pi - PICO Application Notes

Course Code	ECSP305-2				
Category	Programme Elective Course				
Course Title	Elements of IoT Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

List of Experiments

1. Understand the IoT reference Model implementation on various use cases of IoT System in application-specific domains.
2. Identification of elements used in various use cases.
3. Analyse the role and functions of different IoT elements used in different use cases.
4. Proposing a solution based on the IoT reference framework.
5. Evaluating the engineering feasibility of the IoT solution on the basis of:
   a. Hardware platform/resource usage
   b. Communication mode used
   c. Uptime requirements
   d. Scale and volume of data
   e. Security and Maturity

Course Code	ECST305-3				
Category	Program Elective Course				
Course Title	Image Processing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

Course Outcomes

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

1. Describe the foundational principles and terminology associated with digital image processing and computer vision.
2. Utilize fundamental image processing algorithms to enhance the visual quality of images, both subjectively and objectively.
3. Extract meaningful features from images for pattern classification and shape analysis.
4. Develop and implement algorithms for solving real life problems in digital image processing.
5. Demonstrate proficiency in implementing algorithms and techniques learned in the course through hands-on projects using tools like OpenCV, MATLAB, or Python libraries.

Syllabus

Module I: (5 Hours)
Fundamentals of Image processing: pixel, domain, size, resolution, and relationship between pixels. Fundamental Steps in Digital Image Processing. Elements of Visual Perception, Photometric image formation, the digital camera, 2D to 3D projections, and Camera Matrix; Motion models: rotation, translation, and affine, scaling, shearing, matrix representation, low rank transforms composition of transformation.

Module II: (8 Hours)
Image Enhancement in Spatial and Frequency Domain: Basic gray level transformations, Histogram equalization, Smoothing Spatial Filters, Order Statistic Filters, Sharpening Spatial Filters. Image smoothing and sharpening using frequency domain filters.

Module III: (7 Hours)
Image Restoration and Denoising: Model of image degradation/restoration processes; Types of image blur, linear position-invariant degradation, estimation of degradation function, linear and nonlinear image restoration techniques, Inverse filtering, Wiener filtering, Constrained Least Squares Filtering.
Image Denoising: Noise Models, restoration in the presence of Noise only, Introduction to latest filtering techniques: bilateral filtering, Non-local mean filter, PCA for image denoising.

Module IV: (8 Hours)
Image Transforms and Compression models: 2D Orthogonal and Unitary Transforms, Discrete Fourier Transform, Discrete Cosine Transform, KL Transform, Wavelets and Multi resolution Processing: Multi resolution Expansions, Wavelet Transforms in 1D and 2D, The Fast Wavelet Transform.

Image Compression: lossless and lossy, JPEG for gray scale and color image compression, Huffman encoding and run length encoding in JPEG, Structure of Huffman encoder and decoder.

Module V: (6 Hours)
Image Segmentation: Detection of Discontinuities, Edge and Corner Detection, Edge linking and Boundary Detection, Hough Transform, Thresholding, Region-Based Segmentation, Graph-based segmentation, Segmentation by clustering, and normalized cuts.

Module VI: (6 Hours)
Feature Extraction and Applications of Image Processing: Boundary and region feature descriptors, SIFT, HOG feature descriptors, Face Recognition, and Image Pattern Classification, Image Compositing and matting.

Text Books

1. Digital Image Processing by R. C. Gonzalez & R. E. Woods, Pearson education, Fourth edition, 2018.
2. Computer Vision: Algorithms and Applications by Richard Szeliski, Springer, second edition, 2022.

Reference Books

1. Anil K. Jain, "Fundamentals of Digital Image Processing," PHI Learning, Indian edition.
2. Digital Image Processing using MATLAB by R. C. Gonzalez, R. E. Woods & Steven Eddins, Pearson education, second edition, 2017.
3. Feature Extraction and Image Processing for Computer Vision by Alberto S. Aguado and Mark S. Nixon, Academic Press, 3 edition, 2012.
4. Image Processing, Analysis and Machine vision by Milan Sonka, Roger Boyle, and Vaclav Hlavac, Cengage India Private Limited, Fourth edition, 2017.
5. Pattern Classification by Richard Duda, Peter Hart, and David Stork, Wiley, Second edition, 2021.

Course Code	ECSP305-3				
Category	Program Elective Course				
Course Title	Image Processing Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

List of Experiments

1. Fundamental operations on an image (such as reading, displaying, rotation, translation, affine, scaling, shearing, image negative).
2. Image enhancement using point processing operations:
   a) Contrast stretching
   b) Gray Level Slicing
   c) Histogram Equalization
3. Image enhancement using global processing operations:
   a) Spatial Filtering (Image smoothing and sharpening)
   b) Frequency Domain Filtering (Image smoothing and sharpening)
4. Image Restoration in the presence of Noise using global processing operations:
   a) Mean Filters
   b) Order-Statistic Filters
5. Image Deblurring using:
   a) Inverse Filtering
   b) Minimum Mean Square Error (Wiener) Filtering
6. Computation of Image Transforms:
   a) Discrete Fourier Transform
   b) Discrete Cosine Transform
   c) KL Transform
7. Implement JPEG compression and decompression model from scratch for a gray scale image.
8. Detection of Edges and Corners in a given image using:
   a) Laplacian operator
   b) Canny edge detector
   c) Marr-Hildreth edge detector
   d) Harris corner detector
9. Performing image segmentation using:
   a) Thresholding
   b) Region Growing
   c) K-means clustering
   d) Graph-Based Segmentation
10. Develop an application for Face Detection using the fundamentals learned in the course.
11. Develop an application for Face Recognition using the fundamentals learned in the course.
12. Develop an application for Texture classification using:
    a) Prototype matching
    b) Optimal statistical formulation
13. A Capstone Project.

Course Code	ECST305-4				
Category	Program Elective Course				
Course Title	Cloud Computing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

Course Outcomes

On successful completion of the course, the student will be able to:

1. Understand network as resource for cloud
2. Articulate the concepts of cloud computing
3. Implement the concept of virtualization and resource management
4. Demonstrate the measures to be taken for handling fault tolerance and security
5. Provide cloud computing solutions and recommendations for cloud programming and software environments-based applications

Syllabus

Module I: Introduction
Introduction to computer network basics, computing services, servers, databases, networking software, analytics and intelligence, interconnection of peering points, Autonomous systems.

Module II: Cloud Formation
Ubiquitous, convenient on demand network access of pooled resource creation, configuration, customization.

Module III: Models of Cloud
Public, Private and Hybrid Clouds, and service models - Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) methods and technology used.

Module IV: Cloud Virtualization
Hardware/Software/Data servers, Networks infrastructure.

Module V: Service Providers and Their Role
Infrastructure creation/support, security and administration.

Module VI: Use Cases and Resource Provisioning
Oracle cloud infrastructure configuration and management.

Text Books

1. Cloud Computing Principles and Paradigm, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers, 2011.

Reference Books

1. Barrie Sosinsky, Cloud Computing Bible, John Wiley & Sons, 2010.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly, 2009.
3. Cloud Computing: A Practical Approach, Toby Velte, Anthony T. Velte, Robert Elsenpeter, McGraw Hill, 2009.
4. Application notes of AWS
5. Application notes of Azure

Course Code	ECSP305-4				
Category	Program Elective Course				
Course Title	Cloud Computing Lab				
Scheme & Credits	L	T	P	Credits	Semester
	0	0	2	1	V

List of Experiments

Experiments will be based on the following:

1. Formation of cloud
2. Design an application in a cloud environment
3. Demonstrate the use of cloud environment to access cloud storage
4. Resource provisioning on cloud infrastructure
5. Implement concepts of migration and load balancing
6. Deploy security measures and administration

Course Code	ECST 398-1				
Category	Open Elective II				
Course Title	Designing with Arduino				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	V

Course Outcomes

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

1. Use the Arduino IDE for writing, testing and debugging of sketches.
2. Measure physical parameters using Arduino and sensors.
3. Interface devices with Arduino using UART, TWI and SPI protocols.
4. Control DC, stepper and servo motors with Arduino.

Syllabus

Module I
Arduino platform, Prototyping environment, electronic component overview, Arduino IDE, setting up the Arduino board, creating sketches, using Libraries, using example codes, Debugging using the Serial Monitor.

Module II
Arduino C, Data types, Decision making, Loops, Functions, Pointers, Structures, writing sketches using C.

Module III
Sensors, Digital and Analog signals, Temperature sensors, Humidity sensors, Obstacle sensors, Ultrasonic sensor, Accelerometer and gyroscope.

Module IV
Wired and Wireless communication, Communication Protocols- UART, TWI, SPI, Interfacing Communication Modules with Arduino.

Module V
Interfacing Nokia5110 GLCD and SSD1306 OLED displays, displaying text, drawing geometrical shapes, displaying bitmaps on displays.

Module VI
Tone functions, melody generation, Motor interfacing - DC, Servo, Stepper motor with Arduino.

Text Books

1. Arduino for Beginners: Essential Skills Every Maker Needs, John Baichtal, Pearson Education, Inc., 1st edition
2. Beginning C for Arduino by Jack Purdum (ebook)

Reference Books

1. Arduino Cookbook by Michael Margolis, O'Reilly Media, Inc., 1st edition

Course Code	ECSTH501				
Category	Honor				
Course Title	Computer Vision with Embedded Machine Learning				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	V

Course Outcomes

At the end of this course, students will demonstrate the ability to

1. Understand and Apply Basic Concepts of Computer Vision
2. Implement and Evaluate Machine Learning Models for Computer Vision Tasks
3. Integrate Machine Learning Models into Embedded Systems
4. Deploy machine learning models on hardware for computer vision applications
5. integrate computer vision techniques and embedded machine learning, demonstrating practical applications

Syllabus

Module-I

Introduction to Computer Vision, Key applications and use cases, Scope and significance in modern technology, Image Representation and Properties**,** Pixel, image resolution, and color spaces, Image formats and their differences, Image Transformation and Filtering, Convolution and correlation, Smoothing and sharpening filters, Edge Detection and Segmentation, Feature Extraction

Module-II

Convolution operation and kernels, Pooling layers and their significance, Common architectures: LeNet, AlexNet, VGG, ResNet, Layer types: convolutional, pooling, fully connected, dropout, Data augmentation techniques, Transfer learning and fine-tuning pre-trained models, Regularization techniques to prevent overfitting

Module-III

Overview of Embedded Systems for Computer Vision, **Hardware Platforms for Computer Vision,** Camera modules and interfacing techniques, **Real-Time Image Processing,** Techniques for real-time processing: buffering, pipelining, Optimization for speed and efficiency on embedded devices, Configuring Raspberry Pi/NVIDIA Jetson for image capture, Implementing simple image processing tasks on embedded hardware,

Module-IV

Overview of object detection: key concepts and terminology, Traditional Object Detection Methods, Modern Object Detection Techniques, Deploying object detection models on embedded hardware,

Text Books

1. "Deep Learning for Computer Vision", Rajalingappaa Shanmugamani, Packt Publishing, 2018.
2. Computer Vision: Algorithms and Applications by Richard Szeliski, Springer, second edition, 2022.

Reference Book:

1. Practical Deep Learning for Cloud, Mobile, and Edge by Anirudh Koul, Siddha Ganju, and Meher Kasam, O'Reilly Media, 1st Edition: 1st , 2019.

Course Code	ECSTM501				
Category	Minor				
Course Title	Cloud Computing Using Raspberry Pi				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	V

Course Outcomes

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

1. Learn the new computing model which enables shared resources on demand over the network, new kind of service models and deployment models.
2. Classify virtualization technology.
3. Apply the python programming or various services and models.
4. To develop cloud applications in Python and Raspberry Pi

Syllabus

Module I

Principles of Parallel and Distributed Computing, Introduction to cloud computing, Cloud computing Architecture, cloud concepts and technologies, cloud services and platforms, Cloud models, cloud as a service, cloud solutions, cloud offerings, introduction to Hadoop and Map Reduce.

Module II

Cloud Platforms for Industry, Healthcare and education, Cloud Platforms in the Industry, cloud applications. Virtualization, cloud virtualization technology, deep dive: cloud virtualization, migrating in to cloud computing, Virtual Machines Provisioning and Virtual Machine Migration Services, On the Management of Virtual Machines for cloud Infrastructure, Comet cloud, T-Systems

Module III

Cloud computing Applications: Industry, Health, Education, Scientific Applications, Business and Consumer Applications, Understanding Scientific Applications for Cloud Environments, Impact of Cloud computing on the role of corporate IT. Enterprise cloud computing Paradigm, Federated cloud computing Architecture, SLA Management in Cloud Computing, Developing the cloud: cloud application Design.

Module IV

Python Basics, Python for cloud, cloud application development in python, Cloud Application Development in Python. Programming Google App Engine with Python: A first real cloud Application, Managing Data in the cloud, Google app engine Services for Login Authentication, Optimizing UI and Logic, Making the UI Pretty: Templates and CSS, Getting Interactive. Map Reduce Programming Model and Implementations. Raspberry Pi Introduction: Basic functionality, setting and configuration of board, Overlocking, Differentiating from other platforms.

Module V (6 Hours)

Cloud management, Organizational Readiness and change management in the cloud age, Cloud Security, Data security in the cloud, Legal Issues in the Cloud , Achieving Production Readiness for the cloud Services, Implementation using Raspberry Pi

Text books:

1. Cloud Computing: Raj Kumar Buyya , James Broberg, andrzej Goscinski, 2013 Wiley
2. Mastering Cloud Computing: Raj Kumar buyya, Christian Vecchiola, selvi-2013.
3. Cloud Computing: Arshdeep Bahga, Vijay Madisetti, 2014, University Press.

Reference Books:

1. Code in the Cloud: Mark C. Chu-Carroll 2011, SPD.
2. Essentials of cloud computing: K Chandrasekharan, CRC Press.
3. Cloud Computing: John W. Rittinghouse, James Ransome, CRC Press.
4. Cloud Security and Privacy: Mather, Kumara swamy and Latif. 2011. SPD, Oreilly.
5. Virtualization Security: Dave shackleford 2013. SYBEX a wiley Brand.
6. Cloud Computing: Dan C. Marinescu-2013, Morgan Kaufmann.
7. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Syllabus of Semester VI B.Tech.

Department of Electronics and Computer Science

Course Code	ECST306				
Category	Programme Core Course				
Course Title	Database Management System				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes

At the end of the course students will demonstrate the ability to ;

1. Apply the basic concepts of Database Systems and Applications
2. Use the basics of SQL and construct queries using SQL in database creation and interaction
3. Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.

Syllabus

Module I: (5 Hrs)
Overview of Database systems: Basic concepts Database & Database Users, File System vs. DBMS, Database System Concepts & Architecture, Data models, Schemas & Instances, Structure of Relational Database, The Relational Algebra-Fundamental operators and syntax, Extended Relational Algebra operations

Module II: (7 Hrs)
Entity-Relational Model: Basic concepts, Constraints, Keys, Design Issues, Entity-Relational ship Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Features, Transforming ER Model to Relational Data Model.

Module III:(7 Hrs)
Introduction to SQL: Basic Structure, DDL, DML, DCL, structure-creation, alteration, defining constraints- Primary Key, foreign key, unique key, not null, check, IN operator, Set Operations Aggregate Functions, Null Values, Nested Sub-queries, Views, Complex queries, Modification of Database, Joined Relations, Data-Definition Language, Dynamic SQL.

Module IV: (6 Hrs)
Indexing and Hashing: Basic Concepts, Ordered Indices, B+ - Tree Index Files, B-Tree Index Files, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Index Definition in SQL, Multiple-Key Access.

Module V: (6 Hrs)
Transaction Processing: Transactions, ACID Properties, Transaction Schedules & Types, Serializability, Conflict – Serializability, View – Serializability, Testing for Serializability, Concurrency Control: Lock-based Protocols, Time Stamp-based Protocols, Enforcing, Different Locking Modes, 2PL (Two Phase Locking protocol), Multiple Granularity.

Modules VI: (4 Hrs)
Introduction to Advances in Databases: Object-Oriented Databases, Web Databases, Data Warehousing and Mining, Parallel Databases, Distributed Databases.

Text Books

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth and S. Sudarshan, McGraw Hill Education, 6th Edition, 2013.
2. Database Management Systems by Raghu Ramkrishnanand Johannes Gehrke, McGraw Hill Education, 3rd Edition, 2014.
3. SQL, PL/SQL the Programming Language of Oracle by Ivan Bayross, BPB publications, 4th Edition, 2017.

Reference books

1. Fundamentals of Database Systems by RamezElmasri and Shamkant B. Navathe, Addison-Wesley, 6th Edition, 2010.
2. PL/SQL Programming: Oracle Programming 11g by Michael McLaughlin, Oracle Press, McGraw Hill Publications, 2013.

Course Code	ECST307 / ECSP307				
Category	Programme Core Course				
Course Title	Computer Networks				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes

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

1. Understand the basics of computer networking
2. Illustrate the role of each layer of TCP/IP and OSI model
3. Examine the interfaces between each layer of TCP/IP and OSI model
4. Design and evaluate the working of network

Syllabus

Module I: Introduction to Computer Network, types of Networks, Concept of layered network architecture: OSI reference model, TCP/IP model and differences, introduction to circuit, packet and message switching, brief review on various types of transmission medium.

Module II: Application layer: Standard and Nonstandard Application layer Protocols, Concept of Client server and peer-to-peer paradigm, Concepts of Application Programming interface, WWW and HTTP, FTP, Electronic mail, DNS, TELNET

Module III: Transport Layer Services, Transport layer protocols, UDP & TCP, Congestion control.

Module IV: Network layer Services, Performance of network layer, Network layer congestion, Structure of router, Network layer protocols, IPv4 & IPv6 addresses, Forwarding of IP packets, Routing algorithms

Module V: Data link Control and protocols, Multiple access protocols, Link layer addressing, Wired LAN, Point to Point network, SONET, Switched ATM, Connecting Devices, overview of Wireless LAN

Module VI: Principles of cryptography, security and cryptography algorithms, authentication, key distribution and certification, symmetric key algorithm, public key algorithm, digital signature, management of public keys, communication security, email security, recent trends in networking: Software defined network.

Text Books

1. Computer Networks: A Top-Down Approach; Behrouz A Forouzan, Firouz Mosharraf, McGraw Hill Education. Special Indian Edition 2012

Reference Books

1. Data Communications and Networking; Behrouz A. Forouzan, TMH, 4th edition.
2. Computer Networking: A top down Approach; James F. Kurose , Keith W. Ross; Pearson Education, 5th edition.

Course Code	ECST308 / ECSP308				
Category	Programme Core Course				
Course Title	Digital VLSI Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes
At the end of this course students will demonstrate the ability to

1. Acquire knowledge about various NMOS, PMOS and CMOS digital circuits and interconnects
2. Implement digital logic structure of various types
3. Estimate various performance metrics for digital circuits.
4. Analyse memory elements.
5. Analyse performance of moderately sized CMOS circuits by using modern tools to verify the functionality, timing, power and parasitics using schematic and/or layout simulation for a given technology.

Module I:
Overview of VLSI Design Methodology, Design Flow & hierarchy, Introduction to MOS Transistors, Threshold voltage, body effect, MOS device design equations, second order effects, MOS Models-Level-1, Level-2, Level-3.

Module II:
Static Load MOS Inverters, CMOS Inverter: The Static Behavior, Switching threshold, Noise Margins, The Dynamic Behavior, Power, Energy, and Energy-Delay, the Tri State Inverter, Transmission Gate. CMOS fabrication process flow, N-well, P-well, Twin-tub process flow, Silicon on insulator, Latch-up, Layout design rules (DRC).

Module III:
Circuit Characterization and Performance Estimation: Introduction, Resistance Estimation Capacitance Estimation, CMOS gate transistor sizing, Driving Large capacitive loads, Scaling of MOS transistors.

Module IV:
Designing combinational logic gates in CMOS: Complementary CMOS, Ratioed Logic, Pass-Transistor Logic, Dynamic CMOS Design, Dynamic Logic: Basic Principles, Issues in Dynamic Design, Cascading of Dynamic Gates, Domino Logic.

Module V:
Sequential logic design: Timing Metrics for Sequential Circuits, Classification of Memory Elements, Static Latches and Registers, Dynamic Latches and Registers

Module VI:
Clocking Strategies, CMOS Sub-system design: SRAM, DRAM.

Text Book

1. Digital Integrated Circuits: A Design Perspective: J. Rabaey, 2nd edition PHI

Reference Books

1. CMOS VLSI Design: A circuits and systems perspective: N. Weste and K. Eshranghian, 2nd edition, PHI
2. CMOS Digital Integrated Circuits Analysis & Design: S M Kang, Yusuf Lablebici, 3rd edition TMH
3. Basic VLSI Systems and Circuits: Dougles Pucknell and K. Eshraghian 3rd edition, PHI

Course Code	ECST309-1/ ECSP309-1				
Category	Programme Elective Course				
Course Title	System Verilog for Verification				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes:

1. Upon completion of this course, students should demonstrate the ability to
2. Understand and use the System Verilog RTL design and synthesis features, including new data types, literals, procedural blocks, statements, and operators.
3. Apply the System Verilog verification features like OOP'S to build classes and construct objects
4. Apply the SV assertions to validate the behavior of the design
5. Utilize the functional coverage to measure progress during verification, analyze coverage reports and debug coverage holes.

Syllabus:

Module I:
Verification Guidelines: Introduction, Verification Process, Verification Plan, Verification Methodology Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench.

Module II:
Data Types and Procedural Statements: Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Procedural Statements, Tasks, Functions, and Void Functions

Module III:
Basic Object-Oriented Programming: Where to Define a Class, OOP Terminology, Understanding Dynamic Objects

Module IV:
System Verilog Assertions: Types of Assertions and examples

Module V:
Inter-process Communication and Functional Coverage: Working with Threads, Inter-process Communication, Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, Measuring Coverage Statistics During Simulation

Text books:

1. System Verilog for Verification: A Guide to Learning the Testbench Language Features, Chris Spear, Springer 2006
2. Writing Testbenches Using System Verilog, Janick Bergeron, Springer, 2006

Reference books:

1. Writing Testbenches: Functional Verification of HDL Models, Second edition, Janick Bergeron, Kluwer Academic Publishers, 2003.
2. Open Verification Methodology Cookbook, Mark Glasser, Springer, 2009
3. Principles of Functional Verification, Andreas S. Meyer, Elsevier Science, 2004
4. Assertion-Based Design, 2nd Edition, Harry D. Foster, Adam C. Krolnik, David J. Lacey, Kluwer Academic Publishers, 2004.
5. System Verilog for Design: A Guide to Using System Verilog for Hardware Design and Modeling, 2nd Edition, Stuart Sutherland, Simon Davidman and Peter Flake, Springer

Course Code	ECST309-2/ ECSP309-2				
Category	Programme Elective Course				
Course Title	IoT Sensors and Devices				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes

1. Understand the resources and their constricts used in IoT system
2. Apply the understanding in identifying the resource to be used an element in IoT
3. Analyse the suitability of selected element for implementation of the IoT reference
4. Suggest the devices to be used different layers
5. Evaluate the performance of different device at perception network and application layer

Module I: Introduction to Internet of Things Network and IoT layered architecture

Module II: Perception layer devices types and their roles as sensors, nodes, controllers. Different sensing elements for real world parameters like temperature, pressure, humidity, light intensity, magnetic flux, current etc,

Module III: Introduction to Network layer device and their role as Gateways. Actuators at the application of user interface

Module IV: Monitoring real world parameters like temperature, pressure, humidity, light intensity, magnetic flux, current etc,

Module V: Use cases of different sensing element and their actuation, data acquisition, processing at sensors/node

Text Book:

1. Internet of Things Principles and Paradigms, Rajkumar Buyya Amir Vahid Dastjerdi, Morgan Kaufman, Elsevier 2016 1st Edition

Reference Books:

1. Internet of Things Principles, Paradigms and Application of IoT, Joseph Kofi Wireko, Kaml Hiran, BPB Publications 2020 1st Edition
2. Application Notes of Microchip MCP9700, Dallas 18DS20, TMP102, TMP35/36/37
3. Application Notes of BM280, BF350, HX710B MPS20N0040D
4. Application Notes of PIR, Inductive Capacitive Sensors, IN122 Current Sensor
5. Microchip SAMIoT App;ication notes

6. Arduino NanoBLE/ Nano 33IoT Application notes
7. Espressif Application notes ESP32/ESP8266/Node MCU
8. Raspberry Pi- PICO application notes

Practical's: The hands-on lab will be based on the following;

1. Understand the need for sensing in various use cases.
2. Identification of sensors/node to be used in various use cases
3. Analyse and calibrate the sensor for measurement.
4. Proposing a solution based on sensing to fit in the IoT reference frame work
5. Evaluating the engineering feasibility of the sensor used in terms of Sensor type :- analog/digital; Communication mode: Serial/ I2C/SPI etc; Uptime requirements, Calibration needs; Speed of response; Data acquisition, processing method used.

Course Code	ECST309-3/ ECSP309-3				
Category	Programme Elective Course				
Course Title	Deep Learning-I				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes

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

1. Identify key parameters in a neural network's architecture.
2. Develop and implement fully connected deep neural network architecture in a vectorized (efficient) manner.
3. Apply the best practices to train and develop test sets and analyze bias/variance for building deep learning applications.
4. Analyze variance for Deep Learning applications, use standard techniques and optimization algorithms, and check for their convergence.
5. Build and train convolutional neural networks, identify key architecture parameters, and implement vectorized neural networks and deep learning to applications.

Syllabus

Module I: (4 Hrs)
Introduction to Deep Learning: Introduction to Neural Networks, Perceptron, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Supervised Learning with Neural Networks, Binary Classification using Neural Network, Computation Graph, Vectorization.

Module II: (6 Hrs)
Shallow Neural Networks: Neural Network Representation, Activation Functions, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Gradient Descent for Neural Networks, Backpropagation algorithm.

Module III: (6 Hrs)
Optimization Algorithms for Deep Learning: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition.

Module IV: (5 Hrs)
Autoencoders and relation to PCA, Regularization in Autoencoders, Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders.

Module V: (7 Hrs)
Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet,

Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. Image classification.

Module VI: (7 Hrs)
Regularization: Bias Variance Tradeoff, L2 regularization, early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout. Greedy Layer wise Pre-training, Better activation functions, Hyper parameters Tuning.

Text Book:
3. Understanding Deep Learning Book by Simon J. D. Prince, Prince, The MIT Press, 2023.
4. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, & Francis Bach, MIT Press, 2017.

Reference Books:

1. Deep Learning: A Practitioner's Approach by Adam Gibson and Josh Patterson, Shroff/O'Reilly; First Edition, 2017.
2. Dive into Deep Learning by Aston Zhang, Zachary C. Lipton, Mu Li, Alexander J. Smola, Cambridge University Press, 2024
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal, Springer International Publishing, 2018.
4. Deep Learning Illustrated by Jon Krohn, Grant Beyleveld, and Aglaé Bassens, Addison-Wesley; 1st edition, 2019.
5. Recent Research Papers from Reputed Journals and Conferences such as CVPR, ICLR, NIPS, ICML, PAMI etc.

Course Code	ECST309-4/ ECSP309-4				
Category	Programme Elective Course				
Course Title	Data Mining and Warehousing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	2	4	VI

Course Outcomes

1. Understand the Database models IoT reference Model and different element used in it.
2. Apply the understanding in identifying the database system environment
3. Analyse the role of different knowledge discovery databases (KDD)
4. Propose a solution to a real-world problem Backend-frontend system
5. Evaluate the engineering feasibility of the solutions' based on the data storage and retrieval methods

Syllabus

Module I
Introduction to database system Environment, Different models of Databases

Module II
Data storage system, Datamining knowledge discovery Databases (KDD), prediction of data in databases, different models of training

Module III
Data warehousing component: Database (Backend), Data source (UI), Data loaders (Engines), query and analysis tools (Front End)

Module IV
Approaches of schema design, data transformation – cleansing, analytical Progressing (Aggregation)

Module V
Use cases of different data mining algorithm's, Data warehousing in Oracle cloud infrastructure

Text Book

1. *Data Mining and Data Warehousing: Principles and Practical Techniques*, Pratik Bhatia, Cambridge Press, 2019, 1st Edition

Reference Books

1. *Oracle Data Mining Concepts*
2. *Oracle Data Mining User's Guide*
3. *Oracle Database-Data Warehousing Guide*
4. *Oracle Cloud Infrastructure Application Note*
5. *Oracle Live SQL Server Application Note*

Practical's

The hands-on lab will be based on the following:

1. Understand the Database System environment and database models
2. Identification of data storage sources
3. Analyse the role and functions of different KDD in prediction of data
4. Proposing a solution based on different training models for data mining
5. Evaluating the feasibility of the data mining and warehousing system on the parameters:
    - a. Hardware platform/ resource usage
    - b. Latency
    - c. Downtime if any requirements
    - d. Scale and volume of data
    - e. Security and Maturity

Course Code	ECST399-1				
Category	Open Elective				
Course Title	Designing with Raspberry Pi				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VI

Course Outcomes

On successful completion of the course, students will be able to:
1. Wire Raspberry Pi and create a fully functional computer
2. Use Python-based IDE and trace and debug Python code on the device
3. Measure physical parameter using sensors
4. Implement various communication protocols for wired and wireless communication
5. Interfaces different motors and create robots

Syllabus

Module I:
Getting started with Raspberry Pi: Basic functionality of the Raspberry Pi and its Processor, setting and configuring the board, differentiating Raspberry Pi from other platform like arduino, begal, asus thinker etc. Overclocking, Component overview.

Module II:
Introduction to Linux: Implications of an operating system on the behavior of the Raspberry Pi, Overview of Linux and its terminal command, aptget-update, aptget-upgrade, navigating the file system and managing processes, text-based user interface through the shell, overview of graphic user interface.

Module III:
Programming the Raspberry Pi: Python: Introducing to Python programming language; Python Programming Environment, Python Expressions, Strings, Functions, Function Arguments, Lists, List Methods, Control Flow, Numpy, PIP (Python Installation Package) and customized libraries. C++ programming: Basic C++ programming approach, header file structure and library organization, Cross Compiler and its configuration.

Module IV:
Exploring Electronics with the Raspberry Pi: Communication facilities on raspberry Pi (I2C, SPI, UART), working with RPil. GPIO library, Interfacing of Sensors and Actuators.
Project 2: Set UP a Pi motion detector
Project 3: Set UP a Pi ADC/DAC
Project 4: CONSTRUCT a digital weather station
Project 5: CONSTRUCT a Traffic Light Controller

Module V:
Communication using Raspberry Pi: Wired and Wireless communication, TCP, IP configurations, SSH, Putty terminal usage.
Project 6: Set UP file server
Project 7: Network YOUR keyboard and MOUSE
Project 8: Create a portable wireless access point
Project 9: COMMUNICATE with ARDUINO
Project 10: CONSTRUCT a digital server based weather station

Module VI:
Robotic Motion PI: DC, Servo, Stepper, Motor Drivers, Motor Shields, Camera Interfacing, remote data logging.
Project11:Keyboard Control Robot
Project 12: Wireless Robot

Text Books

1. Raspberry Pi 3: An introduction to using with Python Scratch, Javascript and more, Gary Mitnick, CreateSpace IndependentPublishingPlatform, 2017.
2. Raspberry Pi for Python Programmers Cookbook, Tim Cox, Packt Publishing Limited; 2nd Revised edition, 2016.
3. Raspberry Pi User Guide, Eben Uptonand Gareth Halfacree, John Wiley& Sons, 2016.

Course Code	ECSTH601				
Category	Honors Course				
Course Title	Business Considerations for Edge Computing				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	VI

Course Outcomes

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

1. Understand and Apply Edge Computing Concepts.
2. Analyze and Mitigate Security Challenges in Edge Computing.
3. Evaluate the integration of 5G with edge computing.
4. Analyze and evaluate edge computing operations while ensuring compliance with legal, ethical, and security standards.
5. Evaluate role of open-source projects in driving innovation and community-driven solutions.

Syllabus

Module 1 (4 Hrs)
Overview of Edge Computing: Evolution of Computing: Cloud vs. Edge, Basic Edge Computing: Operation, types, architecture, needs; Key Technologies Enabling Edge Computing: 5G Connectivity, Blockchain Edge computing networks.

Module 2 (6 Hrs)
Edge Privacy and Security: Service management and operations, Threat Modelling, Physical Security, Logical Security, Common Security Issues, Application Security, security policy. Cybersecurity in Edge Networks.

Module 3 (6 Hrs)
5G in Edge Computing: Network Slicing and Edge Computing, 5G-Edge Integration: Technical Challenges and Opportunities, 5G-Enabled Edge Computing, AI and Machine Learning at the Edge, Integration of 5G, 6G, and Edge, Decentralized Edge Computing.

Module 4 (5 Hrs)
Operational Aspects of Edge Computing: Automating service delivery, DevOps vs EDGEOPS, Infrastructure as code, Terraform vs Ansible, Edge Computing as a Service (ECaaS), Scalability with automation, edge device and cluster prepping.

Module 5 (7 Hrs)
Legal, Ethical, and Compliance Considerations: Data Privacy and Protection Laws: GDPR & HIPAA, Security Challenges, Mitigating Risks Strategies, Industry Standards and Regulations compliance, Data Interoperability: Principles & Challenges.

Module 6 (7 Hrs)
Role of Influencers and Open-Source Projects: Influencers and their impact, Introduction to Open-Source Software, open source, edge computing, and community-driven innovation, Open source projects on EdgeX Foundry, KubeEdge, OpenEdge, Nervana Systems.

Text Book

1. *Edge Computing: Models, Analytics, and Applications* by Mohsen Guizani, Shancang Li, and S. M. R. Islam, CRC Press, 2018.
2. *The Edge Computing Revolution: Understanding the Edge* by R. K. Gupta, G. R. Gangadharan, and S. K. Sharma, Wiley, 2020.

Reference Books

1. *Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)* by Michael J. Kavis, Wiley, 2014.
2. *IoT and Edge Computing for Architects* by Perry Lea, Packt Publishing, 2018.
3. *Edge Computing for Business: A Guide to the Future of IoT and Big Data* by Rajendra Akerkar, CRC Press, 2021.

Course Code	ECSTM601				
Category	Minor Course				
Course Title	Data Management and Analytics for IoT				
Scheme & Credits	L	T	P	Credits	Semester
	3	1	0	4	VI

Course Outcomes

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

1. Assess storage and retrieval methods through appropriate indexing design
2. Comprehend contemporary database architectures and its relevant issues
3. Analyze the role of database management systems in IOT applications
4. Design and implement structured databases matching to realistic constraints and conditions

Syllabus

Module I (5 Hrs)
Data storage: Overview of Relational DBMS concepts, Basic File Structures, File Organization & Record formats, Heap sorted & Hashed Files, Buffer management, Disk Storage, Parallel Disk access with RAID, Modern Storage Architectures

Module II (7 Hrs)
Indexing Structures: Single level and Multilevel Indexes, B Tree and B+ Tree Indexes, Hash and bitmap-based indexing, Index Structures for Single Dimensional and Multidimensional Databases

Module III (8 Hrs)
Query Processing: Query Execution, Algebra for Queries, Physical-Query-Plan-Operators, Algorithms for Database Operations, Algorithms for Joins and Sorting, hash and index-based algorithms, Buffer Management, Parallel Algorithms for Relational Operators

Module IV (7 Hrs)
Query Optimization: Algebraic Foundation for Improving Query Plans, Estimating Cost of Operations, Cost Based Plan Selection, Choosing Order of Joins, Optimization of Queries for Parallel, Distributed, Multidimensional and Text Database

Module V (6 Hrs)
Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications – Social Networking Analysis - Building a useful understanding of a social network – Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems – citizen actuation

Module VI (7 Hrs)
Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis

Reference Book

1. Ramez Elmasri, Shamkant B Navathe, *Fundamentals of Database System*, Pearson Education
2. Garcia Molina, Ullman, Widom, *Data Base System Implementation*, Pearson Education
3. Raghu Ramakrishnan & Johannes Gehrke, *Database Management Systems*, McGraw Hill
4. Silberschatz, Korth, Sudarshan, *Database System Concepts*, McGraw Hill
5. M. Tamer Ozsu, Patrick Valduriez, S. Sridhar, *Principles of Distributed Database Systems*, Pearson Education

Text Book

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L., *Big Data and The Internet of Things: Enterprise Information Architecture for A New Age*, Apress, 2015
2. Dr. John Bates, *Thingalytics - Smart Big Data Analytics for the Internet of Things*, John Bates, 2015

Syllabus of Semester VII B.Tech.

Department of Electronics and Computer Science

Course Code	ECST 401-1				
Category	Programme Elective Course				
Course Title	VLSI Testing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes:

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

1. Accept challenges in VLSI Testing at different abstraction levels
2. Understand fault models for generation of test vectors, Calculate observability and controllability parameters of circuit Enhance testability of a circuit use simulation techniques for designing and testing of VLSI circuits
3. Identify characteristics of verification methods.

Syllabus:

Module 1: (05 Hours)
Basics of Testing and Fault Modeling- Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation.

Module 2: (9 Hours)
Test Generation for Combinational and Sequential Circuits- Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for Sequential circuits - design of testable sequential circuits.

Module 3: (06 Hours)
Design For Testability -Design for Testability - Ad-hoc design - Generic scan based design - Classical scan based design – System level DFT approaches.

Module 4: (06 Hours)
Self-Test and Test Algorithms -Built-In Self-Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design – Test algorithms - Test generation for Embedded RAMs.

Module 5: (05 Hours)
Fault Diagnosis Logic Level Diagnosis -Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis

Text Book:

1. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
2. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and

Reference Books:

1. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
2. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.

Course Code	ECST401-3				
Category	Programme Elective Course				
Course Title	Deep Learning-2				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes:

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

1. Apply deep learning techniques to real-world problems in computer vision, natural language processing, and speech recognition domains.
2. Implement advanced RNN architectures such as GRU and LSTM to address the challenges of long-term dependencies for sequence modeling tasks such as Image & Video Captioning, and Text Summarization.
3. Develop skills in implementing and fine-tuning deep learning models using popular deep learning frameworks such as Tensor Flow/py Torch.
4. Gain proficiency in utilizing attention mechanisms and transformer architectures for tasks such as neural machine translation and video understanding.
5. Critically evaluate research papers and stay updated with the latest advancements in deep learning research and applications.

Syllabus:

Module 1: (05 Hours)
Advanced concepts in CNN Architectures: Batch Normalization, Better weight initialization methods, Transfer learning, Feature visualization and inversion Adversarial examples Deep Dream and neural style transfer, 3D CNNs.

Module 2: (9 Hours)
Application of CNN: Object Localization and Object Detection, Face Recognition, RCNN, Fast RCNN, Faster RCNN, YOLO, SSD, Visualizing Convolutional Neural Networks, Semantic/Instance/Panoptic segmentation

Module 3: (06 Hours)
Learning Vectorial Representations of Words, Language modeling, Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs.

Module 4: (06 Hours)
Application of RNN: Image captioning, Video captioning, Video Classification, Text Summarization, Language Modelling and Generating Text.

Module 5: (05 Hours)
Encoder Decoder Models, Attention Mechanism, Attention over images, Transformers. Speech Recognition, Neural Machine Translation. Multimodal video understanding.

Module 6: (04 Hours)
Efficient Convolutional Neural Networks for mobile vision- Mobile Nets, Squeeze Net, Shuffle Net, MnasNet.

Text Book:

1. Understanding Deep Learning Book by Simon J. D. Prince, The MIT Press, 2023.
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, & Francis Bach, MIT Press, 2017.

Reference Books:

1. Deep Learning: A Practitioner's Approach by Adam Gibson and Josh Patterson, Shroff/O'Reilly; First Edition, 2017.
2. Dive into Deep Learning by Aston Zhang, Zachary C. Lipton, Mu Li , Alexander J. Smola, Cambridge University Press, 2024
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal, Springer International Publishing, 2018.
4. Deep Learning Illustrated by Jon Krohn, Grant Beyleveld, and Aglaé Bassens, Addison-Wesley; 1st edition, 2019.
5. Recent Research Papers from Reputed Journals and Conferences such as CVPR, ICLR, NIPS,ICML, PAMI etc.

Course Code	ECST 401-4				
Category	Programme Elective Course				
Course Title	System Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Objective:

The objective of this course is to provide conceptual understanding of storage technologies and architectures, data center elements in classic, virtualized and cloud environments. and logical Components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems, storage networking technologies such as FC-SAN, IP-SAN, FCoE, NAS and object-based and unified storage, Understand and articulate business continuity solutions – backup and replications, along with archive for managing fixed content Explain key characteristics, services, deployment models, and infrastructure components for a cloud computing

Course Outcomes:

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

1. Describe and apply storage technologies.
2. Identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers
3. Describe important storage technologies‟ features such as availability, replication, scalability and performance
4. Identify, Manage and Administer need based storage virtualization technologies, servers
5. Design, analyze and manage clusters of resources

Syllabus:

Module I Storage System (7 Hours) :

Introduction to information storage, Virtualization and cloud computing, Key data center elements, Compute, application, and storage virtualization, Disk dive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual provisioning)

Module II: Storage Networking Technologies and Virtualization (7 Hours) Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCL and FCIP as an IP-SAN solutions, Converged networking option – FcoE, Network Attached Storage (NAS) – components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform

Module III: Backup, Archive and Replication (7 Hours)

Business continuity terminologies, planning and solutions, Clustering and multipathing to avoid single points of failure, Backup and recovery – methods, targets and topologies, data deduplication and backup in virtualized environment, fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection

Module IV Securing and Managing (7 Hours)
Storage Infrastructure Security threats, and countermeasures in various domains, Security solutions for FC-SAN, IP-SAN and NAS environments, Security in virtualized and cloud environments, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle Management (ILM) and storage tiering.

Module VI Cloud Computing (7 Hours)
Case studies of Services and deployment models, Cloud infrastructure components, Cloud migration considerations

Text Books:

1. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Educations Services, Wiley, May 2012.

Reference Books:

1. Oracle Cloud Storage Application Note
2. Oracle Cloud Infrastructure Application Note
3. Amazon Cloud Storage Application Note
4. Google Cloud services Application Note: Compute, App Engine,
5. SPANNING BACKUP GOOGLE WORKSPACE

Course Code	ECST 402-1				
Category	Programme Elective Course				
Course Title	Physical Design				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes:

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

1. Interpret the VLSI design flow and various VLSI design styles in detail
2. Apply algorithmic graph theory and combinatorial optimization techniques, as per requirement, to correctly ormulate and solve VLSI design problems
3. Apply the algorithms for partitioning, floor planning, placement and routing of VLSI circuits and use them to solve simple VLSI design problems.
4. Analyze Static Timing Analysis of VLSI circuits.

Syllabus:

Module 1: (06 Hrs)

Introduction to VLSI CAD : VLSI design methodologies, use of VLSI CAD tools, Algorithmic Graph Theory and computational Complexity.

Module 2: (08 Hrs)

High-level Synthesis : Hardware Models for High-level Synthesis, Internal Representation of the Input Algorithm, and Understanding RTL to Gate Level design mapping. Basic concept of Static Timing Analysis (STA).

Module 3: (08 Hrs)

Partitioning: Introduction, Types of Partitioning, Classification of partitioning Algorithm, KL algorithm.

Floor - planning: Introduction, Sliced and non-sliced planning, Polish expression, Power planning, IO Planning.

Placement: Introduction, classification of placement algorithms, partition based placement, timing / congestion aware Placement.

Module 4: (08 Hrs)

Clock Tree Synthesis: Different topologies of Clock Tree Structure. Overview on Clock Mesh implementation for High Performance designs.

Routing : Fundamental Concepts of Steiner trees, Two phases of Routing: Global routing & detailed routing, Routing Algorithms.

Module 5: (08 Hrs)

Low Power Physical Design : Understanding Various Power Optimization algorithms (dynamic and Leakage). Overview on implementation and complexities involved in low power PD.

SOC Physical Design : Re-convergent model of VLSI SOC Design, SOC Physical design, advanced physical design of SOCs

Text Books:

1. VLSI Physical Design Automation: Theory and Practice: Sadiq M. Sait, Habib Youssef, McGraw- Hill 2004

2. VLSI Physical Design: From Graph Partitioning to Timing Closure: Jin Hu, Jens Lienig, Igor L. Markov, Andrew B. Kahng, Springer, Dordrecht 2011.

Reference Books:

1. Physical Design Essentials: An ASIC Design Implementation Perspective: Khosrow Golshan, Springer, (2007).

2. Static Timing Analysis for Nanometer Designs: A Practical Approach: J. Bhasker and Rakesh Chadha, Springer, (2009).

3. Practical Problems in VLSI Physical Design Automation, Sung Kyu Lim, Springer, (2008), ISBN 978-1402066269.

4. Algorithms for VLSI Design Automation: Sabih H. Gerez and John Wiley,(1998).

5. An Introduction to VLSI Physical Design: Majid Sarrafzadeh and C. K. Wong, McGraw Hill, (1996).

6. Algorithms for VLSI Physical Design Automation: Naveed Sherwani, Kluwer Academic Pub., (1999).

Course Code	ECST 402-3				
Category	Program Elective				
Course Title	Natural Language Processing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes

1. Understand the fundamental tasks in natural language processing (NLP) related to syntax, semantics, and pragmatics.
2. Apply knowledge of natural language annotation techniques and text analysis tools.
3. Understand and apply statistical parsing techniques.
4. Implement Semantic Role Labeling (SRL) and Semantic Parsing techniques for understanding sentence meaning and Information Extraction.
5. Identify issues and challenges in Machine Translation.

Syllabus

Module I: Introduction (6 Hours)
NLP tasks in syntax, semantics, and pragmatics. Key issues & Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

Module II: N-gram Language Models (6 Hours)
Role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part of Speech Tagging and Sequence Labeling Lexical syntax. Hidden Markov Models. Maximum Entropy models.

Module III: Syntactic Parsing (6 Hours)
Grammar formalisms and tree banks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs.

Module IV: Semantic Analysis (7 Hours)
Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

Module V: Information Extraction (IE) (5 Hours)
Named entity recognition and relation extraction. IE using sequence labeling. Automatic summarization. Subjectivity and sentiment analysis.

Module VI: Machine Translation (MT) (5 Hours)
Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

Textbook

1. D. Jurafsky and R. Martin, *Speech and Language Processing*, 2nd edition, Pearson Education, 2009.
2. Allen and James, *Natural Language Understanding*, Second Edition, Benjamin/Cumming, 1995.
3. Charniack & Eugene, *Statistical Language Learning*, MIT Press, 1993.

Reference Book

1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal, *NLP: A Paninian Perspective*, Prentice Hall, New Delhi, 1994.
2. T. Winograd, *Language as a Cognitive Process*, Addison-Wesley, 1983.

Course Code	ECST 402-4				
Category	Programme Elective Course				
Course Title	Block Chain				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Objective:

The objective of this course is to provide conceptual understanding of block chain technology and how it can be used in Industry 4.0 The course covers the technological underpinning of block Chain operations in both theoretical and practical implementation of solutions using Ethereum.

Course Outcomes:

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

1. Understand block chain technology and its importance.
2. Identifying the security risks and challenges associated with blockchain technology
3. Implement browser-based wallets and smart contracts in Remix IDE
4. Recognize the importance of blockchain security in various enterprise applications.
5. Develop block chain-based solutions and write smart contract using Ethereum Framework and Deploy Decentralized Application

Syllabus:

Unit I: Blockchain Introduction: 5 Hours

Overview of Block chain, History of Blockchain, Blockchain Objectives, Blockchain Technology Mechanisms & Networks, Blockchain Users & Adoption, Blockchain Challenges, P2P Systems, Hash Pointers and Data Structures, Blockchain Transaction, Types of Blockchain Platform.

Unit II: Consensus Mechanism: 5 Hours

Permissioned Blockchain, Permisionless Blockchain , Different Consensus Mechanism, Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance.

Unit III: Cryptography Fundamentals 6 Hours

Encryption, Digital Signatures, Public-Key Cryptography, Private Key Cryptography, Distributed Denial-of-Service (DDoS) Attack, 51% Attack, Double spending problem, Merkel Tree, Security Threats to Blockchain Technology

Unit IV: Crypto currency and Wallet 6 Hours

Types of Wallets, Desktop Wallet, App based Wallet, Browser based wallet, MetaMask, Creating an account in MetaMask, Use of faucet to fund wallet, transfer of cryptocurrency in MetaMask.

Unit V: Smart contract and Ethereum 7 Hours
Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE, Different networks of Ethereum, understanding blocks in blockchain, compilation and deployment of smart contracts in Remix

Unit VI: Use Cases 6 Hours
Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain, Blockchain in energy sector, Blockchain in governance.

Text Books:

1. Mastering Blockchain: Third Edition by Imran Bashier, Packt Publishing, 2020, ISBN: 9781839213199

Reference Books:

1. Blockchain: Blueprint for a New Economy by Melanie Swan, Oreilly Publication
2. Mastering Ethereum, by Andreas M. Antonopoulos, Gavin Wood
3. Bitcoin and Cryptocurrency Technologies (Princeton textbook) by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder

Course Code	ECST403				
Category	Programme Core Course				
Course Title	Information Security and Cryptography				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes:

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

1. Understand fundamental concepts of information security, including security threats, vulnerabilities, and attack models.
2. Apply cryptographic techniques such as encryption, hashing, and digital signatures to secure data and communications.
3. Analyze authentication mechanisms and access control models to enhance security in systems and networks.
4. Evaluate security threats such as network vulnerabilities, web attacks, and malware, and propose mitigation strategies.

Syllabus:

Module 1: 5 Hrs

Introduction to Information Security : CIA Triad: Confidentiality, Integrity, Availability, Security Threats: Attacks, Vulnerabilities, and Risk Management, Security Models and Policies Case Studies of Real-World Security Breaches

Module 2: 7 Hrs

Fundamentals of Cryptography: Classical Cryptosystems: Substitution and Transposition Ciphers, Symmetric Key Cryptography: DES, AES, Block and Stream Ciphers, Asymmetric Key Cryptography: RSA, Diffie-Hellman, Elliptic Curve Cryptography (ECC), Cryptanalysis Techniques

Module 3: 5 Hrs

Hash Functions and Authentication: Properties of Cryptographic Hash Functions: MD5, SHA-1, SHA-2, SHA-3, Message Authentication Codes (MAC) and HMAC, Digital Signatures: RSA, DSA, ECDSA, Authentication Protocols: Kerberos, OAuth, OpenID

Module 4: 6 Hrs

Network and Web Security: Network Attacks: ARP Spoofing, IP Spoofing, TCP/IP Vulnerabilities, Secure Communication: SSL/TLS, VPNs, IPSec, Web Security Threats: SQL Injection, XSS, SRF, Web Security Mechanisms: HTTPS, CSP, Secure Cookies

Module 5: 6 Hrs

Advanced Cryptography and Emerging Security Trends: Zero-Knowledge Proofs and Homomorphic Encryption, Blockchain and Cryptocurrencies, Post-Quantum Cryptography, Security in IoT and Cloud Computing

Module 6: 6 Hrs

Security in Practice and Defensive Measures: Malware and Threat Analysis (Viruses, Worms, Trojans), Security Tools: Firewalls, IDS/IPS, SIEM, Secure Software Development and Secure Coding Practices, Cybersecurity Laws, Ethics, and Compliance

Reference Books:

1. Cryptography and Network Security: Principles and Practice, Author: William Stallings, Publisher: Pearson, Year: 2023 (8th Edition)
2. Security Engineering: A Guide to Building Dependable Distributed Systems, Author: Ross J. Anderson, Publisher: Wiley, Year: 2020 (3rd Edition)
3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Author: Dafydd Stuttard, Marcus Pinto, Publisher: Wiley, Year: 2017 (2nd Edition)
4. Understanding Cryptography: A Textbook for Students and Practitioners, Author: Christof Paar, Jan Pelzl, Publisher: Springer, Year: 2024 (Latest Edition)

Course Code	ECST404				
Category	Multidisciplinary Course				
Course Title	Cyber Laws and Ethics				
Scheme & Credits	L	T	P	Credits	Semester
	2	0	0	2	VII

Course Outcomes:

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

1. Understand statutory, regulatory, constitutional, and organizational laws for awareness amongst the software professional

2. Classify Ethics and Laws with respect to legal dilemmas in the Information Technology Act

3. Illustrate Privacy and Intellectual property rights related practices

4. Categorize business ethics and roles applicable to IT users, IT professional Malpractice, IT organization workers

Syllabus:

Module I: (04 Hrs)
Cyber laws and rights in today's digital age; IT Act, Intellectual Property Issues connected with use and management of Digital Data, Emergence of Cyberspace, Cyber Jurisprudence.

Module II: (04 Hrs)
Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000, Cyber Torts.

Module III: (04 Hrs)
Ethics in business world, Ethics in IT, Ethics for IT professionals and IT users, IT professional malpractices, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, Types of Exploits and Perpetrators.

Module IV: (05 Hrs)
Intellectual Property: Copy rights, Patents, Trade Secret Laws, Key Intellectual property issues, Plagiarism, Competitive Intelligence, Cyber-squatting, Information warfare policy and ethical Issues.

Module V: (04 Hrs)
Privacy: The right of Privacy, Protection, Key Privacy and Anonymity issues, Identity Theft, Consumer Profiling, Defamation, Freedom of Expression, Anonymity, National, Security Letters, Defamation and Hate Speech

Module VI: (04 Hrs)
Ethics of IT Organization: Contingent Workers H-IB Workers, Whistle-blowing, Protection forWhistleBlowers, Handling Whistle-blowing situation, Digital divide.

Text Books

1. George Reynolds, "Ethic s in information Technology",5th edition, Cengage Learning
2. Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001.

Reference Books

1. Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.
2. Debora Johnson," Computer Ethics", 3rd Pearson Education.
3. Sara Baase, "A Gift of Fire: Social, Legal and Ethical Issues, for Computing and the Internet," PHI Publications.
4. Chris Reed & John Angel, Computer Law, OUP, New York, (2007)

Course Code	ECST498-1				
Category	Open Elective Course				
Course Title	Drone Technology				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VII

Course Outcomes

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

1. Understand the various types drone terminologies to accommodate the electronics, drone structures and its dynamics
2. Apply the knowledge of electronic components, sensors, actuators
3. Create a control and communication system for drone operation
4. Analyse the performance of a drone and state-of-the-art technologies to solve the real-world problems

Syllabus

Module - I : (5 Hrs)

Understanding quad science, drone terminology, current generation of drones based on their methods of propulsion, airspace classification, Levels of autonomy, miniaturization of drones, critical technologies and requirements, Success stories.

Module - II : (6 Hrs)

Sensors principle and typical characteristics, scalar and vector data type sensors, inertial measurement unit, magnetometer, barometer and GPS, thermal sensors, image Sensors, instrumentation systems, data conversion and processing, BLDC motor, servo motors, and its drives, energy sources, battery deployment and charging mechanisms.

Module - III : (6 Hrs)

Overview of the main drone parts, technical specifications of the parts, drone dynamics, propellers design, payload calculations, modelling of drone prototype, 3D Printing technology for drone parts design.

Module - IV : (6 Hrs)

Arduino \ Raspberry-Pi based flight and speed Controller, controller architecture, programming fundamentals, standard library functions, drone control basics, lift generation method, PID Implementation and tuning, flight modes of a drone, safety features, calibration and settings, Exercise
based on different flight controller platforms

Module - V : (6 Hrs)

Networking basics, airborn networks and protocols, IOT architecture, physical design of IoT, communication models & APIs, air-to-ground and air-to-air communication, RC and telemetry transmitter and receiver, Aerial Wi-Fi Networks, networks security, and privacy aspects, Introduction to 5G technology.

Module - VI : (6 Hrs)
Drone inspection, maintenance resources and standards, opportunities and threats from ethical and legal perspectives, frequency spectrum issues Drone applications: agriculture, defence, product delivery, aerial photography, and futuristic drone applications.

Text Books

1. Mark Lafay, *Drones for Dummies*, Wiley, 2015.
2. Jan Holler et al., *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, 1st Edition, Academic Press, 2014.

Reference Book

1. Adam Juniper, The Complete Guide to Drones Extended 2nd Edition, Ilex Press, 2018
2. E.O. Doebelin, D.N. Manik, Measurement systems, 6/E, Tata McGraw Hill, New Delhi, 2011

Syllabus of Semester VIII B.Tech.
Department of Electronics and Computer Science

Course Code	ECST407-1				
Category	Program Elective Course				
Course Title	VLSI Signal Processing				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Course Outcomes:

Students will demonstrate the ability to

1. Explain the basic understanding of discrete signals and systems
2. Apply the pipelining and parallel processing techniques
3. Re-design the DSP systems for the given constraints using retiming techniques
4. Fold and unfold the DSP systems.
5. Analyze data flow in systolic architectures

Syllabus

Module I: Introduction to Digital Signal Processing (DSP) systems, sampling theorem, discrete time signal & systems, representation of discrete systems in Z domain, basic DSP algorithms and its mathematical representation, representation of DSP algorithms using block diagram, data flow graph, dependence graph, signal flow graph, Loop bound and Iteration bound algorithms, difference between recursive(IIR) and non-recursive (FIR) systems

Module II: Basics of pipelining and parallel processing, cut-set theory, data broadcast structure and transpose structure of FIR systems, fine-grain and course-grain pipelining techniques, realizing a parallel architecture for FIR systems, pipelining and parallel processing for low power.

Module III: Retiming algorithm for IIR systems, cut set retiming and pipelining, retiming for clock period minimization, retiming for register minimization.

Module IV: Unfolding algorithms, properties, unfolding for sample period reduction, word level processing, bit level processing, register minimization techniques using folding transformation.

Module V: Folding algorithms, properties, register minimization techniques using folding transformation.

Module VI: Systolic architecture design, block diagram, space representation, edge mapping table, low level implementations, space time representation for systolic arrays.

Text book:

1) VLSI Digital Signal Processing Systems, Keshab K. Parhi, A Wiley-Interscience Publication, 1999

Course Code	ECST 407-3				
Category	Program Elective Course				
Course Title	Generative Adversarial Network				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Course Outcomes:

1. Develop a comprehensive understanding of the foundational principles underlying Generative Adversarial Networks (GANs).
2. Distinguish between various GAN architectures, discerning their respective strengths and weaknesses in different applications.
3. Demonstrate proficiency in implementing GAN models, utilizing popular deep learning frameworks like TensorFlow and PyTorch.
4. Employ appropriate evaluation techniques to critically assess the performance and quality of generated outputs from GANs.
5. Utilize GANs effectively across diverse real-world scenarios, recognizing their potential impact and addressing ethical considerations.

Syllabus:

Module I:
Introduction to Generative Adversarial Networks (GANs):
Overview of Generative Models, Introduction to GANs: History and Evolution, Basic Components of GANs: Generator and Discriminator, Understanding the Generative Process in GANs, Applications of GANs in Various Fields, Ethical Considerations and Challenges in GANs

Module II:
Fundamentals of GAN Architectures:
Architectural Overview: Vanilla GAN, DCGAN, CGAN, etc., Generator Architecture: Feedforward vs. Convolutional Networks, Discriminator Architecture: Convolutional Neural Networks (CNNs) in GANs
Loss Functions in GANs: Minimax Game, Jensen-Shannon Divergence, Wasserstein Distance, Training GANs: Challenges and Strategies, Evaluating GAN Performance: Metrics and Techniques

Module III:
Advanced GAN Architectures and Techniques:
Conditional GANs (cGANs): Incorporating Auxiliary Information, Progressive GANs: Training High-Resolution Images, StyleGAN and StyleGAN2: Style-Based Generative Models, CycleGAN: Unpaired Image-to-Image Translation, Attention Mechanisms in GANs, Self-Attention Generative Adversarial Networks (SAGANs), Other Variants and Innovations in GAN Architectures

Module IV:
Practical Implementation of GANs:
Setting up Development Environment: Python, TensorFlow, PyTorch, Data Preparation and Preprocessing for GAN Training, Implementing Vanilla GAN from Scratch, Hands-on Projects: Image Generation with DCGAN, Image-to-Image Translation with CycleGAN, Text-to-Image Generation with StackGAN,Sketch-to-Image Generation with Pix2Pix

Module V:
GANs in Real-world Applications and Future Directions:
GANs in Computer Vision: Image Generation, Super-Resolution, Inpainting; GANs in Natural Language Processing: Text Generation, Dialogue Generation; GANs in Healthcare: Medical Image Analysis, Drug Discovery; GANs in Creative Industries: Art Generation, Music Generation; Ethical Considerations and Societal Impact of GANs; Future Directions and Emerging Trends in GAN Research

Textbooks:

1. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster, O'Reilly Media, 2019.
2. "GANs in Action: Deep learning with Generative Adversarial Networks" by Jakub Langr, Vladimir Bok, and Hannes Hapke, Manning Publications, 2020.

Reference Books:

1. "Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras" by Rajalingappaa Shanmugamani, Packt Publishing, 2018.
2. "Hands-On Generative Adversarial Networks with PyTorch 1.x: Implement next-generation neural networks to build powerful GAN models using Python" by Michael O'Rourke, Packt Publishing, 2020.

Course Code	ECST407-4				
Category	Program Elective-V				
Course Title	Big Data Web Intelligence				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Objective:

The objective of this course is to provide conceptual understanding of Big Data Service (Hadoop-based data lakes), Data Intelligence Platform (for data integration and management), and Analytics Cloud (for visual analytics and dashboards)

Course Outcomes:

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

1. Understand Big Data Service and its components
2. Identify the storing-processing and analytics
3. Integration to data sources
4. Identify and deploy Visual Analytics and self-service discovery
5. Integration of enterprise analytics, data exploration and self-service analytics

Syllabus:

Unit I: Big Data Service (7 Hours)

Introduction to Hadoop environment for building secure and scalable data lakes, HDFS (Hadoop Distributed File System) and other Hadoop components like Hive, HBase, Spark, and Oozie

Unit II: Integration of Cloud Infrastructure services for storage and compute (7 Hours)

Storing and processing various data formats and types, Building data pipelines for ETL (Extract, Transform, Load) processes, Running analytics workloads on large datasets.

Unit III: Data Intelligence Platform (7 Hours)

Connections to various data sources, including Oracle Fusion applications, databases, and cloud services. data transformation and cleansing, Supports open formats like Delta Lake, Parquet, Iceberg, and Hudi. Integration with Oracle Autonomous Data Warehouse and Oracle Analytics Cloud.

Unit IV: Oracle Analytics Cloud (8 Hours)

Visual analytics, self-service discovery, and enterprise analytics, data exploration and self-service analytics.

Unit V: Case Studies of big Data Cloud Service (6 Hours)

Text Books:

1. Hadoop: The Definitive Guide, Fourth Edition by Tom White, O'Reilly Media 2015

Reference Books:

1. Oracle® Cloud Getting Started with Oracle Cloud Applications E41248-94 February 2025
2. Oracle® Cloud Using Oracle Big Data Cloud Service Release 19.3.3 E62152-45 September 2019
3. Hadoop in Practice Second Edition ALEX HOLMES, M A N N I N G Shelter Island

Course Code	ECST408-1				
Category	Program Elective Course				
Course Title	Nano electronics				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Course Outcomes:

Upon the completion of this course, students will demonstrate the ability to:

1) Show a deeper understanding of the relation between novel behaviour of nanoelectronics devices and quantum behaviour.
2) Appreciate scaling issues and ideas behind nanoscale fabrication technologies.
3) Analyse the principles of devices such as tunnelling, single electron transistor.
4) Design and analysis of Nano structure and Nano electronics devices.
5)To explore emerging nanoelectronics technologies and applications.

Syllabus:

Module I: Introduction to Nanoelectronics, Overview of nanoelectronics and its significance, History and evolution of nanoelectronics.

Module II: Basic principles of quantum mechanics relevant to nanoelectronics, Schrödinger equation, Quantum confinement effects, Quantum tunnelling and its implications in nanoelectronics, Quantum states, wave functions, Quantum dot.

Module III: Nanomaterials, Graphene, Carbon nanotube and Nanowires and applications, Synthesis of Carbon Nanotubes.

Module IV: Single electron transistor, Tunnel junctions and applications of tunneling, Coulomb Blockade.

Module V: Fabrication techniques, Lithography techniques (e-beam, photolithography, nanoimprint lithography), Deposition and etching methods.

Module VI: Spintronics devices and applications, Principles of nanoscale electronic devices, Nanoscale interconnects, Applications of nanoelectronics

Text Books:

1. Fundamentals of Nanoelectronics, first Edition, George W. Hanson, Pearson education,Prentice Hall, (2008).
2. Introduction to Nanotechnology, C.P. Poole Jr., F.J. Owens, Wiley (2003).
3. Nanoelectronics and Information Technology (Advanced Electronic Materials and Novel Devices), Waser Ranier, Wiley-VCH, (2003)

Reference Books:

1. Nanosystems, K.E. Drexler, Wiley (1992).
2. Introduction to Nanoelectronics : Science, Nanotechnology, Engineering & Applications by Vladimir.V.Mitin, Cambridge University Press 2008.

Course Code	ECST 408-3				
Category	Program Elective Course				
Course Title	Reinforcement Learning				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Course Outcomes:

1. Understand and articulate the foundational principles and algorithms of Reinforcement Learning.
2. Implement and experiment with various RL and DRL algorithms to solve complex decision-making problems.
3. Analyze and evaluate the performance of RL models in diverse environments and applications.
4. Stay informed about current research trends and advancements in the field of Deep Reinforcement Learning.

Syllabus:

Module I:
Introduction to Reinforcement Learning:
Fundamental concepts: agents, environments, states, actions, rewards; Markov Decision Processes (MDPs), Exploration vs. exploitation dilemma, Dynamic programming methods.

Module II:
Value-Based Methods in RL:
Monte Carlo methods, Temporal Difference (TD) learning, Q-Learning algorithm, SARSA (State-Action-Reward-State-Action)

Module III:
Policy-Based and Actor-Critic Methods:
Policy gradient methods, REINFORCE algorithm, Actor-Critic architectures, Advantage Actor-Critic (A2C)

Module 4:
Deep Reinforcement Learning Techniques:
Introduction to neural networks in RL, Deep Q-Networks (DQN), Double DQN and Dueling DQN, Deep Deterministic Policy Gradient (DDPG), Trust Region Policy Optimization (TRPO) and Proximal Policy Optimization (PPO)

Module 5:
Advanced Topics and Applications:
Multi-agent reinforcement learning, Hierarchical reinforcement learning, Meta-learning in RL, Real-world applications: robotics, game playing, finance, Ethical considerations and safety in RL.

Textbooks:

1. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto, MIT Press, 2nd Edition, 2018

Reference Books:

1. **"Deep Reinforcement Learning"** by Aske Plaat, Springer, 1st Edition, 2022.
2. **"Grokking Deep Reinforcement Learning"** by Miguel Morales, Manning Publications, 1st Edition, 2020.
3. **"Deep Reinforcement Learning Hands-On"** by Maxim Lapan, Packt Publishing, 2nd Edition, 2020.

Course Code	ECST408-4				
Category	Program Elective Course				
Course Title	Bioinformatics				
Scheme & Credits	L	T	P	Credits	Semester
	3	0	0	3	VIII

Course Outcomes:

1. To use and describe bioinformatics data, information resource and also to use the software effectively from large databases
2. Acquire a knowledge of computational techniques of biological science.
3. Broad understanding of resources available to biological scientists.
4. Effectively employ the knowledge to implement computational projects.
5. Application of bioinformatics methods used to relate sequence to structure and function.

Syllabus:

Module I: (07 Hrs)
Introduction to Bioinformatics and Basic Programming: Bioinformatics, applications of Bioinformatics, Introduction to basic scripting and programming
routinely used for bioinformatics analysis

Module II: **(07 Hrs)**
Sequence and Molecular File formats: Introduction to different file formats used for biological data. Sequence and molecular file conversion tools.

Module III: **(07 Hrs)**
Databases in Bioinformatics: Introduction to different biological databases, their classification schemes, and biological database retrieval systems.

Module IV: (07 Hrs)
Sequence Alignments: Introduction to concept of alignment, Scoring matrices, Alignment algorithms for pairs of sequences including Dot Matrix plot, Dynamic programming and Heuristic algorithms such as BLAST, Multiple sequence alignment (CLUSTAL), Global and local alignment algorithms.

Module V: **(07 Hrs)**
Motif Identification: Introduction to motif identification in DNA and proteins including consensus and probabilistic approaches.

Text books:

1) Bioinformatics: Methods and Applications Genomics, Proteomics, and Drug Discovery S.C. Rastogi, N. Mendiratta, P. Rastogi (3rd Edition) PHI Learning Private Limited New Delhi (2011).
2) Bioinformatics Principles and Applications. Z. Ghosh and B. Mallick Oxford University Press. (2015), ISBN 10: 0195692306; ISBN 13: 9780195692303.