VARDHAMAN COLLEGE OF ENGINEERING
(AUTONOMOUS)
Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade, **ISO 9001:2015** Certified
Kacharam, Shamshabad, Hyderabad - 501218, Telangana, India

www.vardhaman.org

CURRICULUM

For

Bachelor of Technology

Electronics and Communication Engineering

Under

Choice Based Credit System (CBCS)

B. Tech. - Regular Four-Year Degree Program

(For batches admitted from the Academic Year 2022 - 2023)

&

B. Tech. - Lateral Entry Scheme

(For batches admitted from the Academic Year 2023 - 2024)

October 2022

Vision of the Institution:

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

Mission of the Institution:

- To adopt innovative student centric learning methods.
- To enhance professional and entrepreneurial skills through industry institute interaction.
- To train the students to meet dynamic needs of the society.
- To promote research and continuing education.

Vision of the Department:

To produce competent engineers with social responsibility to address the global challenges in the field of Electronics and Communication Engineering

Mission of the Department:

- Promote active learning strategies to facilitate student centric learning.
- Provide self learning capabilities to enhance employability and entrepreneurial skills.
- Inculcate human values and ethics to make learners sensitive towards societal issues.
- Strengthen core competencies among the learners through experiential curriculum.

Program Educational Objectives(PEOs):

PEO1: Graduates will be able to foster continuing education with their existing knowledge in the field of Electronics and Communication Engineering.

PEO2: Graduates will be able to evolve with the ever-changing global technological advancements and cater to the needs of the society.

PEO3: Graduates will be able to demonstrate leadership skills to address issues in a responsive, ethical and innovative manner.

PEO4: Graduates will be able to excel in a career while contributing to the growth of their organization.

Program Outcomes(POs):

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2:Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3:Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4:Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5:Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6:The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7:Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8:Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9:Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10:Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11:Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12:Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes(PSOs):

Graduates will be able to,
PSO1: Apply the knowledge of domain-specific skill set for the design and analysis of components in VLSI and Embedded systems.
PSO2: Demonstrate the technical competency and use appropriate techniques in the realization of advanced communication systems.

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

Regulations: VCE-R22

I Year I Semester										
Induction Program (Phase – I)										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8001	Matrices and Calculus	BS	3	1	0	4	40	60	100
2	A8006	Applied Physics	BS	3	0	0	3	40	60	100
3	A8501	Problem Solving through C	ES	3	0	0	3	40	60	100
4	A8204	Basic Electrical Engineering	ES	2	0	0	2	40	60	100
5	A8401	Digital Logic Design	ES	3	0	0	3	40	60	100
6	A8007	Applied Physics Laboratory	BS	0	0	2	1	40	60	100
7	A8502	Problem Solving through C Laboratory	ES	0	0	2	1	40	60	100
8	A8205	Basic Electrical Engineering Laboratory	ES	0	0	2	1	40	60	100
9	A8301	Engineering Workshop	ES	0	0	2	1	40	60	100
10	A8021	Social Innovation	ES	0	0	2	1	40	60	100
Total				14	01	10	20	400	600	1000

I Year II Semester										
Induction Program (Phase – II)										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8002	Ordinary Differential Equations and Vector Calculus	BS	3	1	0	4	40	60	100
2	A8008	Engineering Chemistry	BS	3	0	0	3	40	60	100
3	A8010	English for Skill Enhancement	HS	2	0	0	2	40	60	100
4	A8505	Data Structures	ES	3	0	0	3	40	60	100
5	A8403	Electronic Devices and Circuits	ES	2	0	0	2	40	60	100
6	A8009	Engineering Chemistry Laboratory	BS	0	0	2	1	40	60	100
7	A8011	English Language and Communication Skills Laboratory	HS	0	0	2	1	40	60	100
8	A8507	Data Structures Laboratory	ES	0	0	2	1	40	60	100
9	A8404	Electronic Devices and Circuits Laboratory	ES	0	0	2	1	40	60	100
10	A8302	Computer Aided Drawing	ES	0	0	2	1	40	60	100
11	A8022	Engineering Exploration	ES	0	0	2	1	40	60	100
Total				13	01	12	20	440	660	1100

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

Regulations: VCE-R22

II Year I Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8004	Numerical Methods and Complex Variables	BS	3	1	0	4	40	60	100
2	A8211	Network Analysis	PC	3	0	0	3	40	60	100
3	A8407	Electronic Circuit Analysis	PC	3	0	0	3	40	60	100
4	A8408	Signals and Systems	PC	3	0	0	3	40	60	100
5	A8409	Probability Theory and Stochastic Process	PC	3	0	0	3	40	60	100
6	A8410	Electronic Circuit Analysis Laboratory	PC	0	0	2	1	40	60	100
7	A8411	Basic Simulation Laboratory	PC	0	0	2	1	40	60	100
8	A8412	Digital Logic Design Laboratory	PC	0	0	2	1	40	60	100
9	A8023	Engineering Design Thinking	PW	0	0	2	1	40	60	100
Total				15	01	08	20	360	540	900
Mandatory Courses (Non-Credit)										
10	A8031	Gender Sensitization	MC	2	0	0	0	-	100	100
11	A8033	Universal Human Values 2: Understanding Harmony	MC	2	0	0	0	-	100	100

II Year II Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8013	Business Economics and Financial Analysis	HS	3	0	0	3	40	60	100
2	A8415	Analog Electronic Circuits	ES	3	0	0	3	40	60	100
3	A8416	Computer Organization and Microprocessors	PC	3	0	0	3	40	60	100
4	A8417	Analog Communications	PC	3	0	0	3	40	60	100
5	A8418	Electromagnetic Theory and Transmission Lines	PC	3	0	0	3	40	60	100
6	A8419	Analog Electronic Circuits Laboratory	PC	0	0	2	1	40	60	100
7	A8420	Computer Organization and Microprocessors Laboratory	PC	0	0	2	1	40	60	100
8	A8421	Analog Communications Laboratory	PC	0	0	2	1	40	60	100
9	A8527	Applied Python Programming Laboratory	ES	0	0	2	1	40	60	100
10	A8024	Product Realization	PW	0	0	2	1	40	60	100
Total				15	00	10	20	400	600	1000
Mandatory Courses (Non-Credit)										
11	A8032	Environmental Science and Technology	MC	2	0	0	0	-	100	100

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

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III Year I Semester											
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8422	Digital Communications	PC	3	0	0	3	40	60	100
2	A8423	Antennas and Wave Propagation	PC	3	1	0	4	40	60	100
3	A8424	Control Systems	PC	3	1	0	4	40	60	100
4	A8425	Microcontrollers	PC	3	1	0	4	40	60	100
5		Professional Elective – I	PE	3	0	0	3	40	60	100
6	A8426	Digital Communications Laboratory	PC	0	0	2	1	40	60	100
7	A8427	Microcontrollers Laboratory	PC	0	0	2	1	40	60	100
Total				15	03	04	20	280	420	700
Mandatory Courses (Non-Credit)										
8	A8034	Indian Constitution	MC	2	0	0	0	-	100	100

III Year II Semester											
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8428	CMOS VLSI Design	PC	3	0	0	3	40	60	100
2	A8429	Digital Signal Processing	PC	3	0	0	3	40	60	100
3	A8430	Microwave Engineering	PC	3	0	0	3	40	60	100
4		Professional Elective – II	PE	3	0	0	3	40	60	100
5		Professional Elective – III	PE	3	0	0	3	40	60	100
6	A8431	CMOS VLSI Design Laboratory	PC	0	0	2	1	40	60	100
7	A8432	Digital Signal Processing Laboratory	PC	0	0	2	1	40	60	100
8	A8012	Advanced English Communication Skills Laboratory	HS	0	0	2	1	40	60	100
9	A8041	Mini-Project/Internship	PW	0	0	4	2	40	60	100
Total				15	00	10	20	360	540	900
Mandatory Courses (Non-Credit)										
11	A8035	Research Methodology	MC	2	0	0	0	-	100	100

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

Regulations: VCE-R22

IV Year I Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1	A8435	IoT Architectures and Protocols	PC	3	0	0	3	40	60	100
2	A8436	Mobile Communications and Networks	PC	3	0	0	3	40	60	100
3		Professional Elective – IV	PE	3	0	0	3	40	60	100
4		Professional Elective – V	PE	3	0	0	3	40	60	100
5		Open Elective – I	OE	3	0	0	3	40	60	100
6	A8437	IoT Architectures and Protocols Laboratory	PC	0	0	2	1	40	60	100
7	A8438	Advanced Communications Laboratory	PC	0	0	2	1	40	60	100
8	A8042	Project Work Phase - I	PW	0	0	6	3	100	-	100
Total				15	00	10	20	380	420	800

IV Year II Semester										
#	Course Code	Title of the Course	Category	Hours per Week and Credit				Assessment Marks		
				L	T	P	C	CIE	SEE	Total
1		Professional Elective – VI	PE	3	0	0	3	40	60	100
2		Open Elective – II	OE	3	0	0	3	40	60	100
3		Open Elective – III	OE	3	0	0	3	40	60	100
4	A8043	Project Work Phase - II	PW	0	0	22	11	40	60	100
Total				09	00	22	20	160	240	400

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

Regulations: VCE-R22

List of Professional Electives

Professional Elective - I		
Domain	**Course Code**	**Title of the Course**
VLSI	A8451	SystemVerilog for Verification
Embedded Systems	A8452	Real Time Operating Systems
Signal Processing	A8453	Digital Image Processing
Communications	A8454	Computer Communication Networks

Professional Elective - II		
Domain	**Course Code**	**Title of the Course**
VLSI	A8455	FPGA Design
Embedded Systems	A8456	Advanced Core Architecture
Signal Processing	A8457	Machine Learning for Visual Analysis
Communications	A8458	Wireless Communications and Networks

Professional Elective - III		
Domain	**Course Code**	**Title of the Course**
VLSI	A8459	CMOS Analog IC Design
Embedded Systems	A8460	Embedded System Design
Signal Processing	A8461	Machine Learning for Signal Processing
Communications	A8462	Satellite and Radar Communications

Programme Curriculum Structure
B. Tech – Electronics and Communication Engineering

Regulations: VCE-R22

List of Professional Elective (Cont.)

Professional Elective - IV		
Domain	**Course Code**	**Title of the Course**
VLSI	A8463	VLSI Physical Design Automation
Embedded Systems	A8464	Sensors and Actuators
Signal Processing	A8465	Artificial Neural Networks
Communications	A8466	Optical Communications

Professional Elective - V		
Domain	**Course Code**	**Title of the Course**
VLSI	A8467	Low Power VLSI Design
Embedded Systems	A8468	System on Chip Architecture
Signal Processing	A8469	Biomedical Signal Processing
Communications	A8470	Wireless Sensor Networks

Professional Elective - VI		
Domain	**Course Code**	**Title of the Course**
VLSI	A8471	High Speed VLSI Design
Embedded Systems	A8472	IoT Security and Gateway
Signal Processing	A8473	Electronic Measurements and Instrumentation
Communications	A8474	5G and Beyond Communications

List of Open Electives

#	Course Code	Title of the Course
1	A8181	Smart Cities
2	A8182	Disaster Management
3	A8183	Environmental Pollution Management
4	A8155	Green Building and Sustainability
5	A8224	Electric Vehicles
6	A8281	Solar Energy and Applications
7	A8282	Energy Storage Systems
8	A8283	Power Generation Systems
9	A8381	Hybrid Vehicles
10	A8382	Fundamentals of Robotics
11	A8383	3D Printing
12	A8402	Digital Electronics
13	A8481	Basic Electronics
14	A8482	Principles of Communication Engineering
15	A8483	Fundamentals of IoT
16	A8484	Introduction to Embedded Systems
17	A8510	Operating Systems
18	A8514	Database Management Systems
19	A8520	Software Engineering
20	A8607	Information Security
21	A8608	Java Programming
22	A8651	Ethical Hacking
23	A8652	Cyber Security
24	A8656	Blockchain Technology
25	A8658	Robotic Process Automation
26	A8681	E-Commerce
27	A8682	Full Stack Development
28	A8702	Artificial Intelligence
29	A8781	Computer Organization and Architecture
30	A8851	Data Science for Engineers
31	A8081	Mathematical Programming
32	A8082	Transform Calculus
33	A8083	Numerical Techniques
34	A8084	Entrepreneurship Development
35	A8085	Logistics and Supply Chain Management

List of Open Electives (Cont.)

#	Course Code	Title of the Course
36	A8086	Management Science
37	A8087	Human Resource Management
38	A8088	Organizational Behaviour
39	A8089	Intellectual Property Rights
40	A8090	Professional Practice, Law & Ethics
41	A8091	National Cadet Corps (NCC)

I YEAR I SEMESTER

Course Structure

A8001 - Matrices and Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the solution of system of linear equations, eigen values and eigen vectors, functions of several variables, multiple integrals. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography, wireless communication and animation.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8001.1. Solve system of linear equations using rank of a matrix.
A8001.2. Examine the nature of quadratic form using eigen values and eigen vectors.
A8001.3. Evaluate improper integrals using Beta and Gamma Functions.
A8001.4. Examine the extremum of a function of several variables.
A8001.5. Make use of multiple integrals to find the area and volume of a solid.

3. Course Syllabus

Theory of Matrices: Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss- Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

Eigen Values and Eigen Vectors: Linear Transformation and Orthogonal Transformation, Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem. Rank, index, signature and nature of quadratic forms up to three variables using eigen values.

Calculus: Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series, Definition of Improper Integral: Beta and Gamma functions and their applications.

Multivariable Calculus (Partial Differentiation and applications): Definitions of Limit and Continuity, Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

Multivariable Calculus (Integration): Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Change of variables (Cartesian to polar), Evaluation of Triple Integrals. Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

4. Books and Materials

Text Books:

1. Grewal, B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V. Higher Engineering Mathematics, 32nd Reprint, McGraw Hill Education (India) Pvt Ltd, 2018.

Course Structure

A8006 - Applied Physics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Applied Physics course introduces the fundamental aspects of physics with applications to modern scientific world and focuses on recent trends in science and technology. This interdisciplinary knowledge which includes quantum computing, semiconductors, lasers, wave optics, optical fibers and nanomaterials encourage an understanding of technological applications of Physics. It's importance as a subject of social and industrial relevance enable the students to solve various engineering problems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8006.1. Analyze the properties of quantum computers by quantum physics.
A8006.2. Apply wave property of light to study different optical phenomenon.
A8006.3. Interpret the charge carrier dynamics in semiconductors.
A8006.4. Develop communication systems by means of lasers and optical fibers.
A8006.5. Analyze the principles of nanoscience and technology for electronic applications.

3. Course Syllabus

Quantum Mechanics and Quantum Computing: Introduction to quantum physics, Blackbody radiation, Photoelectric effect, de-Broglie hypothesis, G.P. Thomson experiment, Concept of wave function, Heisenberg uncertainty principle, Time independent Schrödinger wave equation, One-dimensional potential box, Introduction to quantum computing, Bits and qubits, Classical and quantum logic gates, Interference and quantum entanglements, quantum teleportation and cryptography, IBM quantum, Application of quantum computers.

Wave optics: Waves and wavefronts, Huygens' principle, Superposition of waves, Constructive and destructive interference, Interference of light by Wavefront splitting – Young's double slit experiment, Amplitude splitting – Newton's rings, Diffraction: Fraunhofer and Fresnel diffraction, Diffraction of light at single slit, Diffraction grating – Intensity distribution of light.

Semiconductors and Devices: Intrinsic and extrinsic semiconductor, Density of states, Fermi-Dirac distribution function, Carrier concentration in intrinsic semiconductor, Direct and indirect bandgap semiconductor, Structure, Working principle and Characteristics of P-N junction diode, Hall effect, Light Emitting Diode (LED) and Solar cell.

Lasers and Optical fibers: Introduction to lasers, Einstein's coefficients, three and four level laser systems, Ruby laser, He-Ne laser, Semiconductor laser, Applications of lasers, Introduction to optical fibers, Structure of optical fiber, Total internal reflection, Step index and Graded index optical fibers, Acceptance angle - Numerical aperture, Optical fibers in communication System, Applications of optical fibers.

Nanoscience: Introduction of nanomaterials, Surface area to Volume ratio, Quantum confinement, Top-down fabrication: Ball milling and Chemical Vapor Deposition (CVD) methods, Bottom-up fabrication: Sol-Gel and Combustion methods, Characterization techniques: X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Applications of nanomaterials.

4. Books and Materials

Text Books:

1. Pandey, B. K. and Chaturvedi, S., Engineering Physics, 1st Edition, New Delhi: Cengage Learning India Pvt. Ltd, 2013
2. Bernhardt, Chris., Quantum computing for everyone, MIT Press, 2019.

Reference Books:

1. Palanisamy, P.K, Engineering Physics, 1st Edition, Scitech Publications, 2013
2. David Halliday, Jearl Walker, Robert Resnick, David G. Rethwisch, William D. Callister, Engineering Physics, 6th Edition, Wiley India Pvt Ltd, 2006
3. Brij Lal and Subrahmaniyam, A textbook of Optics, 23rd Edition, S Chand, 2006.

Course Structure

A8501 - Problem Solving through C

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

As an introductory course common to all branches, the student will be able to learn problem solving skills using 'C ' programming language, which is a pre-requisite to learn many other programming Languages. The purpose of this course is to provide the basic programming methodology in C. This course will enable the students to learn programming skills necessary to implement all the basic mathematical, scientific and real world applications. C is a structured high-level programming language. The student can write programs using structures, functions and pointers. The course enables to perform file operations to store data permanently. This course will give the foundation for a beginner to develop computer programmes effectively.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8501.1. Identify various building blocks to write a C program.
A8501.2. Use control statements for solving a given problem.
A8501.3. Write programs using arrays and strings to store and manipulate sequential data.
A8501.4. Build programs with functions and structures for solving a complex problem.
A8501.5. Make use of Pointers and Files to store and retrieve data efficiently.

3. Course Syllabus

Algorithms, Flowcharts and Introduction to C : Algorithms- Definition, characteristics and examples. Flowcharts- Definition, Symbols and examples. Structure of a C Program, Identifiers, Variables, Constants and Data Types. Operators-Arithmetic, Relational, Logical, Assignment, increment and decrement, Conditional, Bitwise and Special Operators. Evaluation of Expressions, Precedence of Arithmetic operators, Type conversions, Operator precedence and Associativity. Formatted input and output.

Control Statements: Conditional Statements- if, if else, nested if, else if ladder and switch statements. Iterative or Loop statements- while, do while and for statements. Jump statements- break, continue and goto statements.

Arrays and Strings : Arrays: Introduction, One Dimensional Arrays - Declaration and initialization, Reading and Writing. Two Dimensional Arrays - Declaration and initialization, Reading and Writing. Strings: Introduction, Declaration and initialization, Reading and writing, string handling functions, handling two dimensional strings, Command line arguments.

Functions, Structures and Unions: Functions- Introduction, Function definition and Function call, Categories of functions, Recursion, Limitations of recursive functions, Passing Arrays to functions, Common Preprocessor Directives. Structures- Definition, Declaration and Initialization, accessing structure members, Array of Structures, Arrays with in structures, Structures and functions , size of structures , Unions- Definition, Declaration and Initialization, accessing Union members.

Pointers and Files : Pointers-Declaration, Initialization, Pointer to Pointer, Pointer Arithmetic, Parameter Passing Techniques, Pointer to Arrays, Pointers to Structures. Files- Introduction, defining, opening and closing a File, Input - Output operations on Files, Random Access in files.

4. Books and Materials

Text Books:

1. Byron Gottfried., Programming with C, 4th Edition (Schaum's Outlines), New Delhi,Mc GRAW HILL Edition, 2018.
2. E Balagurusamy., Programming in ANSI C, 8th Edition, Tata McGRAW HILL, New Delhi, 2019.

Reference Books:

1. Yeshvanth Kanethkar., Let Us C,5th Edition,BPB Publications, New Delhi,India, 2017.
2. B.A. Forouzan and R.F. Gilberg., Computer Science: A Structured Programming Approach Using C, 3rd Edition, Thompson Learning, 2007.
3. P. Padmanabham., C & Data structures, 3rd Edition, B.S. Publications, 2016.
4. Jeri R. Hanly and Elliot B.Koffman.,Problem solving and Program Design in C, 7th Edition,Pearson Publication, 2016.

Course Structure

A8204 - Basic Electrical Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	2	40	60	100

1. Course Description

Course Overview

Basic Electrical Engineering course serves as a theoretical foundation aimed at enriching students' understanding of electric circuits, DC and AC machines, while fostering analytical abilities. This course delves into the foundational concepts and methodologies integral to Electrical Engineering, covering various aspects such as electrical circuits, network theorems, and operational principles of key components including DC machines (motors and generators), Transformers, Induction motors, and Synchronous generators.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8204.1 Apply DC circuit principles, network reduction techniques, and theorems to solve Complex DC circuits.

A8204.2 Analyze single-phase AC circuits using sinusoidal waveforms, average and RMS values, and j-notation.

A8204.3 Analyze 1-phae transformer principles, construction, EMF equation, and no-load and on-load conditions.

A8204.4 Analyze the operation and characteristics of DC generators and motors, including EMF and torque equations.

A8204.5 Evaluate the construction, operation, and torque characteristics of three-phase induction motors and synchronous generators.

3. Course Syllabus

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law, KVL and KCL, Types of sources, Source transformation, Network reduction techniques (Series, Parallel and Star-Delta), Mesh and Nodal analysis, Superposition theorem, Thevenin's and Norton's theorems (DC Excitation only) - Numerical problems.

AC Circuits: Representation of sinusoidal waveforms, Average & RMS value, Peak factor, Form factor, j- notation, Analysis of single-phase AC circuits consisting of R, L, C, RL, RC, RLC combinations (series circuits only) - Numerical problems.

Single Phase Transformers: Working principle and constructional details, Types-Core and Shell type transformers, EMF equation, Transformer operation on NO load and ON load Conditions - Numerical problems on EMF equation.

DC Machines: D.C. Generators - Construction, Principle of operation, E.M.F. equation, Methods of excitation - Separately excited and Self-excited generators- Numerical problems on EMF equation. D.C Motors – Principle of operation, Concept of Back E.M.F., Torque equation, Torque-Speed characteristics of DC Shunt motor - Conceptual description only.

AC Machines: Generation of rotating magnetic fields, Construction and working of a three-phase Induction motor, Concept of slip, Torque production- Starting and Running torques, Torque-Slip characteristics - Numerical problems on slip. Construction of Synchronous generator-Salient pole and Non-salient pole generators, Working principle of synchronous generator, No-Load Characteristics - Conceptual description only.

4. Books and Materials

Text Books:

1. William Hart Hayt, Jack Ellsworth Kemmerly, Steven M. Durbin(2007), Engineering Circuit Analysis, 9th Edition, McGraw-Hill Higher Education, New Delhi, India.
2. B.L. Theraja, A.K. Theraja, A text book of Electrical Technology,(Vol 1&2), S. Chand Publishers, New Delhi.

Reference Books:

1. D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, 3rd Edition, Tata Mc-Graw Hill, 2010.
2. D.C. Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill, 2009.
3. L.S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.

Course Structure

A8401 - Digital Logic Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to teach students the fundamentals of digital logic design. The course starts with the basic postulates of Boolean algebra, the map method for simplifying Boolean expressions, the formal procedures for the analysis and design of combinational and sequential circuits, design of memory and programmable devices. These digital components are the basic building blocks from which more complex digital systems are constructed.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8401.1. Apply Boolean algebra and minimization techniques to simplify a Boolean function.
A8401.2. Build combinational circuits using logic gates.
A8401.3. Analyze the behavior of latches and flip-flops for designing sequential logic.
A8401.4. Construct synchronous sequential circuits using flip-flops and combinational logic.
A8401.5. Make use of Programmable Logic Devices in the design of digital systems

3. Course Syllabus

Boolean Algebra and Logic Gates: Introduction, basic definitions, axiomatic definition of Boolean algebra, basic theorem and properties, Boolean functions, canonical and standard forms, digital logic gates. **Gate-Level Minimization:** The map method, two, three & four-variable K-map, product-of-sums simplification, sum-of-products simplification, don't-care conditions, NAND and NOR implementation.

Combinational Logic: Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, BCD adder, magnitude comparator, decoders, encoders, multiplexers, demultiplexers.

Sequential Logic: Gated latch, clocked S-R flip-flop, D and T Flip flop, clocked JK flip-flop, Master-Slave J-K flip flop, design of synchronous and asynchronous counters, design of various types of shift registers.

Synchronous Sequential Logic: Moore and melay systems, state diagrams and tables, state reduction. Case studies- sequence detector, traffic light controller and vending machine.

Memory and Programmable Logic: Random-Access Memory, read-only memory, programmable logic array, programmable array logic.

4. Books and Materials

Text Books:

1. M. Morris Mano, Michael D. Ciletti (2017), Digital Design With an introduction to the Verilog HDL, 6thEdition, Pearson Education/ PHI, India

Reference Books:

1. Ronald J Tocci, Ronald J Tocci, Neal S Widmer , Gregory L Moss , Digital Systems - Principles an Applications , 10th Edition, Pearson Education International
2. Charles H RothJr, Larry L Kinney, Fundamentals of Logic Design,6th Edition, Cengage Learning

Course Structure

A8007 - Applied Physics Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Applied Physics Laboratory covers the concepts of semiconductors, communication systems and wave optics. These experiments have number of applications and are valuable tool in the arsenal of engineers across multiple domains. This course also makes students familiar with the instrumental methods and various electrical properties of semiconducting devices. This basic knowledge will enable the scientific fervor to solve various engineering problems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8007.1. Evaluation of properties of light radiation by wave optics.
A8007.2. Interpret the principles of semiconductors.
A8007.3. Determine the properties of laser light and estimate losses in optical fibre.
A8007.4. Analyze the VI characteristics of LED and solar cell.
A8007.5. Apply resonance principle to calculate frequency of AC supply.

3. List of Experiments

1. Determination of the wavelength of Sodium light by Newton's rings method.
2. Determination of wavelengths of spectral lines of Mercury (Hg) source using diffraction grating.
3. Determination of threshold voltage and study the V-I characteristics of LED.
4. To Study the V-I characteristics of PN junction diode under Forward and Reverse bias conditions.
5. Verification of the type of semiconductor material by estimating the density of majority carriers using Hall Effect.
6. Determination of the energy bandgap of a given semiconductor.
7. Determination of quality factor of solar cells and it's V-I Characteristics.

8. Determination of the wavelength of a given source of Laser light using plane transmission grating.
9. Evaluation of the numerical aperture (NA) and transmission losses of a given optical fiber.
10. Evaluation of frequency (n) of an AC supply, using Sonometer.

4. Laboratory Equipment/Software/Tools Required

1. Newton's Ring kit
2. Spectrometer
3. Regulated power supply (DC and AC)
4. Hall Effect Setup
5. Light Emitting Diode Kit
6. Solar cell Kit
7. Sonometer Setup
8. Semiconductor Laser Source
9. Plane diffraction grating
10. Optical fiber trainer kit
11. Meters - Ammeter, Voltmeter, Digital Multimeter
12. Diodes, Resistors, Capacitors, Bread Board

5. Books and Materials

Text Books:

1. Sushil Kumar Jain, Majeet Singh, Applied Physics Experiments, JBC Press, 2013

Reference Books:

1. S B Mal, Er. Ashish Jesuja Practical Physics for Engineering Students of B.Tech, JBC Press, 2015
2. Applied Physics Laboratory Manual, Department of Physics, VCE 2022

Course Structure

A8502 - Problem Solving through C Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

As an introductory course common to all branches, the student will be able to learn problem solving skills using 'C' programming language, which is a pre-requisite to learn many other programming Languages. The purpose of this course is to provide the basic programming methodology in C. This course will enable the students to learn programming skills necessary to implement all the basic mathematical, scientific and real world applications. C is a structured high-level programming language. The student can write programs using structures, functions and pointers. The course enables to perform file operations to store data permanently.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8502.1. Use various programming constructs of C to solve a given problem.
A8502.2. Make use of arrays, pointers and structures to organize data.
A8502.3. Develop applications using functions for code reuse.
A8502.4. Write programs using files for storing and accessing data.

3. List of Experiments

1. Variables and Expressions
   a. Write a C program for Swapping of two numbers using a third variable
   b. Write a C program for the simple and compound interest.
   c. Write a C program to evaluate the expressions. (Finding y=m*x+c, displacement).
2. Operators
   a. Write a C program to implement increment, decrement and Bitwise operators
   b. Write a C program to find the greatest of 3 numbers using conditional operator.
3. Conditional Statements-I
   a. Write a C program for finding the max and min from the three numbers.

b. Write a C program to Check the given year is leap year or not.

c. Write a C program to find the roots of a quadratic equation. .

4. Conditional Statements-II

a. Write a C program to check the given number is power of 2 or not using bit wise operators.

b. Write a C program to read 3 subject Marks. Calculate and display the grade of a student based on the percentages.

c. Write a C Program to perform Arithmetic Operations using switch statement.

5. Iterative Statements-I

a. Write a C program to find sum of n natural numbers (1+2+3....+n).

b. Write a C program to find factorial of a given number.

c. Write a C program to print Fibonacci numbers.

d. Write a C program to find reverse of the given number.

e. Write a C program to Check if the binary representation of a positive number is palindrome or not. For example, 101, 11, 11011, 1001001 are palindromes. 100, 110, 1011, etc., are not palindromes.

6. Iterative Statements-II

a. Write a C program to read a password until it is correct. For wrong password print "Incorrect password" and for correct password print "Correct password" and quit the program. The correct password is 1234.

b. Write a C program to check the given number is prime or not.

c. Write a C program to find the GCD of given two numbers.

d. Write a C program to print the output in various triangle patterns using Nested for loop.

e. Write a C Program to find the sum of the series Geometric Progression.

7. Arrays

a. Write a C program to find the largest and smallest number among a list of integers.

b. Write a C Program to read an array of n elements and find the mean, variance and standard deviation.

c. Given an integer array of election votes having candidate IDs, write a program to find the winner of the election.

8. Multi Dimensional Arrays

a. Write a C program to find Addition of two Matrices.

b. Write a C program to find Multiplication of two Matrices.

9. Strings

a. Write a C program to demonstrate the string handling functions.

b. Write a C program to Check whether a given string is palindrome or not.

c. Write a C program to concatenate three strings.

d. Write a C program to count the lines, words and characters in a given text.

10. Functions

a. Write a C program to find the factorial of a given number using non-recursive and recursive function

b. Write a C program to find the nth term of a Fibonacci series using recursive function.

c. Write a c program to compute x power y.

11. Structures

a. Write a C program to create a Student structure containing name, rollNo and grade as structure members. Display the name, rollNo and grade of a student.

b. Write a C program to create a Book structure containing name, author and pages as structure members. Display the name, author and pages of a Book.

c. Write a C Program to Create a Student structure containing name, rollNo and grade as structure members. Display the name, rollNo and grade of n students by using array of structures concept.

12. Structures

a. Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

b. Write a C Program to Add Two Distances (in inch-feet system) using Structures

13. Pointers

a. Write a C program to swap two integers using following methods.

i) Call by Value ii) Call by Reference

b. Write a C program to demonstrate pointer arithmetic.

c. Write a C Program to Check the given string is palindrome or not using pointer.

d. Write a C program to print n cities names using pointers and strings.

14. Files

a. Write a C program to merge two files into a third file.

b. Write a C program to reverse the contents of a file.

c. Write a C Program to use random access functions in files.

4. Laboratory Equipment/Software/Tools Required

1. Computer Systems (PCs) installed with Ubuntu OS (Open Source/ Freeware)
2. GCC Compiler (Open source / Freeware).

Course Structure

A8205 - Basic Electrical Engineering Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The Basic Electrical Engineering Laboratory provides students with practical hands-on experience to deepen their understanding of electric circuits, DC and AC machines, and to foster the development of analytical skills. This course delves into the fundamental concepts and methodologies underpinning Electrical Engineering, covering various aspects such as electrical circuits, network theorems, and the principles and operating conditions of DC machines (motors and generators), Transformers, Induction motors, and Alternators. Through practical applications and experimentation, students engage in active learning to solidify their comprehension and proficiency in the field of Electrical Engineering.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8205.1. Analyze and demonstrate the application of Ohm's Law and Kirchhoff's Laws in DC and AC circuits.

A8205.2. Demonstrate practical application and evaluation skills by analyzing and verifying Superposition, Thevenin's, and Norton's theorems in provided circuits.

A8205.3. Analyze and interpret the torque-speed and performance characteristics of DC motors to evaluate their operational efficiency.

A8205.4. Analyze the open-circuit, short-circuit, and performance test results of transformers and AC machines to assess their key parameters and operational characteristics.

3. List of Experiments

1. Verification of Ohm's Law.
2. Verification of KVL and KCL.
3. Verification of Super position theorem.
4. Verification of Thevenin's theorem.
5. Verification of Norton's theorem.

6. Calculations and Verification of Impedance, Voltage and Current of series RL and series RC circuits.
7. OC and SC Tests on Single Phase Transformer.
8. Measurement of transformation ratio of Single Phase Transformer.
9. Torque-Speed Characteristics of a DC Shunt Motor.
10. Torque-Speed Characteristics of 3-phase Induction Motor.
11. Performance Characteristics of a Separately Excited DC Motor.
12. No-Load Characteristics of a Three-phase Alternator.

4. Laboratory Equipment/Software/Tools Required

1. Bread Boards, Resistors of different values, Regulated Power Supply.
2. 1-Phase Transformer, DC Machines, 3-phase Induction Motor, Alternator.
3. Voltmeter, Ammeter, Tachometer, Rheostats and Watt meters (LPF and UPF).

Course Structure

A8301 - Engineering Workshop

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Engineering Workshop is an establishment of space and facility where the students acquire the knowledge on different materials, equipment, tools and workshop practices that are the core methods of engineering industry. This course is of prime importance which makes the learner competent in handling practical work in all types and trades of engineering. It also develops the skills with dignity of labour, precision, safety at work place, team working innovative ideas in making and development of right attitude.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8301.1. Identify the trade based materials and tools to prepare the models.
A8301.2. Illustrate each trade and tool by hands on training in making the models.
A8301.3. Apply different workshop practice methods towards workshop models.
A8301.4. Analyze the trade based operations in the process of product development.
A8301.5. Develop a progressive product towards a societal need.

3. Course Syllabus

PART – A (Demonstration)

1. CNC Machining.
2. Additive Manufacturing with one Model.
3. Power Tools, Plastic Moulding, Metal Casting.
4. Welding (TIG/MIG, Gas Welding), Brazing.

PART - B (Practical)

1. Fitting : L - Fit / V - Fit / Square – Fit / Semi Circular - Fit.
2. Carpentry : Cross Lap Joint / Dovetail Joint / T – Lap Joint / Corner Lap Joint.
3. House wiring : Series / Parallel / One Bulb One Switch / Tube Light / Two-way switch.

4. Welding : Butt Joint / Lap Joint / T Joint .
5. Foundry : Single Piece / Multi Piece.
6. Tin Smithy : Open Scoop / Funnel / Rectangular Tray / Cylindrical
7. Plumbing : Pipe Threading / Pipe Joints.

Note: Minimum one experiment from each Trade with total of 12 Experiments

4. Laboratory Equipment/Software/Tools Required

1. Fitting : Bench vise, Hacksaw frame, Calipers, Files, Try Square
2. Carpentry : Carpentry vise, Chisels, Saws, Wooden Hammer, Try Square
3. House wiring : Wiring Bundles, Socket Pins, Tester, Poker, and Cutting Plier
4. Welding : Welding M/c, Safeguards, Chipping Hammer, Electrode Holder
5. Foundry : Wooden patterns, Riddle, Riser, Runner, Gate cutter, Rammers
6. Tin Smithy : Wire Gauge, Snips, Pliers, Steel rule, Soldering kit, Nylon Hammers.
7. Plumbing : Pipe Wrench, Pipe Cutter, Pliers, Pipe Die Set
8. Additional : Model Joints and Electric Boards

Course Structure

A8021 - Social Innovation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Social Innovation is an open-ended course to develop social connectedness in engineering students through social awareness and social consciousness. This can be done through live field exposure along with faculty led conceptual presentations, real case reviews, self-study assignments, literature and field survey. Through this course, the students are expected to use their engineering knowledge to provide innovative solutions to existing social problems. This course also develops critical thinking ability among the students to develop sustainable solutions.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8021.1. Develop awareness on social issues faced by local regions.
A8021.2. Identify the mind set of human Race and interpret the societal issues as simple, complicated, and complex problems.
A8021.3. Identify the need statement along with its main causes and effects.
A8021.4. Develop an innovative and sustainable solution for social issues by thinking critically and creatively.

3. Course Syllabus

Introduction to Social Innovation: Core definitions, core elements and common features of social innovation, a typology of social innovation, Awakening social consciousness.

Create Mindsets and Wicked Problems: Seven mindsets – Empathy, Optimism, Iteration, Creative confidence, making it, embracing ambiguity, Learning from failures. Distinguish between simple, complicated, and complex problems; describe the characteristics of wicked problems, breakdown a given problem by unpacking its complexity.

Critical and Creative Thinking for Social Innovation: Definition, engineering thinking and learning, distinguish between creativity and innovation. Models of Creative thinking. [Appreciative Inquiry (AI), Asset Based Community Development (ABCD) and Concept of Bricolage.

Process of Social Innovation: Community study, develop questionnaire, identifying the causes of a particular problem, identify needs, record your learning's, generate ideas, select promising ideas, prototyping, and testing.

Social Innovation across Four Sectors: The non-profit sector, public sector, the private sector, the informal sector, links between and cross sectors. Stages of Innovation: Social organizations and enterprises, social movements, social software and open source methods, common patterns of success and failure.

4. Books and Materials

Text Books:

1. Robin Murray, Julie Caulier-Grice, Geoff Mulgan, "The open book of social innovation: Ways to Design, Develop and Grow Social Innovation", The Young Foundation, 2010.
2. Julie Caulier-Grice, Anna Davies, Robert Patrick & Will Norman, The Young Foundation (2012) Social Innovation Overview: A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research.

Reference Books:

1. Geoff Mulgan, "Social Innovation: What it is, Why it matters and How it can be accelerated", The Young Foundation, 2007.
2. Asset Based Community Development (ABCD) Model – http://www.nurturedevelopment.org/asset-based-community-development/
3. Diana Whitney & Amanda Trosten-Bloom, "The Power of Appreciative inquiry – A Practical Guide to Positive Change", 2nd Edition, Berrett-Koehler Publishers, Inc, 2010.

I YEAR II SEMESTER

Course Structure

A8002 - Ordinary Differential Equations and Vector Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with ordinary differential equations of first and higher order and Laplace transforms, vector calculus. In addition, this course can be applied in many areas of engineering such as wireless communication, signal processing, robotics and animation.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8002.1. Solve ordinary differential equations of first and higher order.
A8002.2. Make use of ordinary differential equations to solve engineering problems.
A8002.3. Apply Laplace transforms to solve ordinary differential equations.
A8002.4. Determine divergence and curl of a vector point function.
A8002.5. Make use of vector integral theorems to evaluate area, surface area and volumes

3. Course Syllabus

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

Ordinary Differential Equations of Higher Order: Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x) and xV(x), method of variation of parameters, Equations reducible to linear ODE with constant coefficients: Cauchy-Euler equation. Applications: L-C-R Circuits.

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function, Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

Vector Differentiation: Vector point functions and scalar point functions, Gradient, Directional derivatives, Divergence and Curl, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

Vector Integral Calculus: Line integral, work done, Surface integrals, Volume integrals. Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem (without proof) and their applications.

4. Books and Materials

Text Books:

1. Grewal, B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing House, 2011.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V. Higher Engineering Mathematics, 32nd Reprint, McGraw Hill Education (India) Pvt Ltd, 2018.

Course Structure

A8008 - Engineering Chemistry

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course emphasizes a strong background of Chemistry, infused with an orientation towards the applied chemistry and materials technology. A course that focuses on the general applications of chemical principles to the analysis and evaluation of engineering problems as water and its treatment for various purposes, engineering materials as plastics, fibres, elastomers, composites, non-conventional energy sources, batteries and fuel cells.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8008.1. Apply the knowledge of electrochemical series to protect different metals from corrosion.

A8008.2. Analyze the hardness and other impurities present in the water for industrial and domestic applications.

A8008.3. Evaluate the behaviour of different engineering materials.

A8008.4. Analyze the different types of fossil fuels, characteristics and their applications.

A8008.5. Compare the materials to study various physical and chemical properties.

3. Course Syllabus

Battery Chemistry & Corrosion:

Batteries: Classification – Primary battery (dry cell and lithium cell) and Secondary battery (Lithium-ion cell and lead acid battery). Fuel cells – Hydrogen-Oxygen fuel cell– Engineering applications, Solar cells - Introduction and applications of Solar cells. **Corrosion and Its Control:** Causes and effects of corrosion – Theories of Corrosion – Chemical corrosion – oxidation corrosion, Electrochemical theory of corrosion - mechanism. Types of corrosion – Galvanic corrosion – Concentration cell corrosion (Pitting corrosion and Waterline corrosion). Factors affecting the rate of corrosion, Pilling-Bedworth rule, corrosion

control methods – cathodic protection – sacrificial anodic – impressed current cathodic protection.

Water and its treatment: Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness, Numerical problems. Boiler troubles: sludges, scales and caustic embrittlement. Internal treatment of boiler feed water – Calgon conditioning – Phosphate conditioning – Colloidal conditioning – Softening of water by ion exchange processes. Potable water – its characteristics. Desalination of water – Reverse osmosis. Sewage – Steps involved in treatment of sewage.

Polymeric Materials: Terminology, Types of Polymerization – Addition and Condensation polymerization with examples. Characteristics of Plastics, fibres and elastomers. Plastics: Thermo- plastic resins & Thermosetting resins. Preparation, properties and engineering applications of Polyvinyl chloride and Teflon. Fibers: Preparation, properties and engineering applications of Nylon-6,6 and Dacron. Elastomers: Natural rubber and its vulcanization, Artificial rubbers - Buna-S and Butyl rubber. Conducting Polymers: Classification, mechanism of conduction in trans - polyacetylene – applications.

Energy Sources: Introduction, Calorific value of fuel – HCV, LCV- Dulongs formula – Numerical Problems. Classification- solid fuels – coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, Cracking and its types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition, characteristics and applications of LPG and CNG, Biodiesel – Transesterification, advantages

Engineering Materials:

Nanomaterials: Introduction, Chemical synthesis by sol-gel, precipitation, solvo-thermolysis and thermolysis methods. Applications of nanomaterials in Industry and Engineering.

Graphene: Isolation, Structure and strength, applications in Computer, Electrical and Electronic Devices.

Alloys: Definition – Purpose of alloying, Types of alloys – Ferrous Alloys (Stainless steel, Nichrome, Alnico), Non-ferrous alloys (solder, brass and bronze).

Portland cement: Chemical constituents, Setting and Hardening and applications of cement.

4. Books and Materials

Text Books:

1. Rama Devi. B, Aparna. P, Prasanta Rath, Engineering Chemistry, 2nd Edition, Cengage

Publications, 2022.

2. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publication Company, 2015.

Reference Books:

1. Shikha Agarwal, Engineering Chemistry, Cambridge University Press, Delhi, 2015.
2. Shashi Chawla, Engineering Chemistry, Dhanpatrai and Company (P) Ltd. Delhi, 2011.
3. Thirumala Chary. M, Laxminarayana. E and Shashikala. K, A text book of Engineering Chemistry, Pearson Publications, 2021.

Course Structure

A8010 - English for Skill Enhancement

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	2	40	60	100

1. Course Description

Course Overview

This course has been designed to develop linguistic and communicative competencies among engineering students. The Reading and Writing skills of the students are honed during the sessions using the prescribed textbook. Additional focus is laid on grammar and vocabulary. In addition, the students are encouraged to read texts which are aimed at developing their comprehension skills.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8010.1. Build competence in grammar for effective communication.
A8010.2. Acquire suitable vocabulary required for achieving communicative competence.
A8010.3. Utilize academic reading skills to comprehend different texts effectively.
A8010.4. Develop effective writing skills for academic purposes.
A8010.5. Demonstrate basic proficiency in professional correspondence.

3. Course Syllabus

'Toasted English' by R.K.Narayan

Vocabulary : Word Formation - Prefixes and Suffixes; Synonyms and Antonyms; Conjunctions

Grammar : Identifying Common Errors in Writing with Reference to Articles and Prepositions

Reading : Techniques for Effective Reading

Writing : Sentence Structures -Use of Phrases and Clauses in Sentences- Types of sentences; Punctuation; Techniques for Writing precisely – Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

'Appro JRD' by Sudha Murthy

Vocabulary : Homophones, Homonyms and Homographs

Grammar : Identifying Common Errors in Writing with reference to Tenses, Noun-pronoun Agreement and Subject-verb Agreement

Reading : Sub-Skills of Reading – Skimming and Scanning

Writing : Essay writing; Precis writing

Lessons from Online Learning' by F.Haider Alvi, Deborah Hurst et al

Vocabulary : Words Often Confused; Idioms

Grammar : Misplaced Modifiers

Reading : Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for Practice

Writing : Letter Writing: Letter of Request, Letter of Inquiry, Letter of Apology, Letter of Complaint.

'Art and Literature' by Abdul Kalam

Vocabulary : Standard Abbreviations in English

Grammar : Redundancies and Clichés in Oral and Written Communication

Reading : Survey, Question, Read, Recite and Review (SQ3R Method)

Writing : Information Transfer; Letter of Application and Resume/CV writing; Email writing- format, style and etiquette.

Chapter entitled 'Go, Kiss the World' by Subroto Bagchi

Vocabulary : Technical Vocabulary and their Usage

Grammar : Identify the errors with reference to Active and Passive Voice; Reported speech

Reading : Reading Comprehension: Exercises for Practice.

Writing : Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

4. Books and Materials

Text Books:

1. English: Language, Context and Culture by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

Reference Books:

1. Raman, Meenakshi and Sharma, Sangeeta, Technical Communication- Principles and Practice, 3rd Edition, Oxford University Press, New Delhi. Print, 2015.
2. Muralikrishna C. and Sunita Mishra, Communication Skills for Engineers, 2nd Edition, Pearson, 2011
3. Ashraf Rizvi M, Effective Technical Communication, 2nd Edition, McGraw Hill Education, 2017
4. Swan, Michael, Practical English Usage, Oxford University Press. Fourth Edition, 2016.
5. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary, 2nd Edition, Sage Publications India Pvt. Ltd.

Course Structure

A8505 - Data Structures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Data Structures is a course for an engineering graduate to improve the programming skills using C Language. It is a logical model of organizing data, used in designing and implementing efficient algorithms. Data structures are important as they are implemented in every software application. This course covers various operations on Singly Doubly Linked Lists. The linear data structures stacks and queues are implemented using both arrays and linked lists. The course also includes fundamental terminology of non-linear data structures like Trees and Graphs which are especially used to handle large amount of data. The course will also enable the use of appropriate searching and sorting method in handling collection of elements.

Course Pre/co-requisites

A8501 - Problem Solving through C

A8502 - Problem Solving through C Laboratory

2. Course Outcomes (COs)

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

A8505.1. Select appropriate sorting and searching technique for a given application.
A8505.2. Use various forms of linked lists to perform operations on data efficiently.
A8505.3. Build applications using stack data structure for real time applications.
A8505.4. Construct various forms of Queues to solve a real time problem.
A8505.5. Make use of nonlinear data structures for organizing data.

3. Course Syllabus

Searching and Sorting: Asymptotic Notations, Time Complexity and Space Complexity of algorithms, Introduction to Searching, Linear search and Binary search. Introduction to Sorting, Bubble sort, Selection sort, Insertion sort, Merge Sort and Quick sort.

Dynamic Memory Allocation and Linked Lists: Introduction, Dynamic Memory Allocation Functions: malloc, calloc, free and realloc. Self-Referential Structures. Linked List-

Introduction, Basic Terminologies, Linked Lists versus Arrays, Operations on Singly Linked Lists and Doubly Linked Lists. (Create, insert, delete, reverse, display and count).

Stacks: Introduction, Array and Linked List representation of Stacks, Operations on Stack using Array and Linked List. Applications of Stacks: Infix to Postfix conversion, Evaluation of Postfix Expression.

Queues: Introduction, Array and Linked List representation of Queues, Operations on Queue using Array and Linked List. Circular Queue and Deque implementation using arrays.

Trees and Graphs: Introduction to Trees, Basic Terminologies, Representation of Binary Tree and Tree Traversal Techniques- Pre order, In order and Post order. Introduction to Graphs, Graph Terminology, Directed Graphs, Non Directed Graphs, Representation of Graphs.

4. Books and Materials

Text Books:

1. Reema Thareja., Data Structures Using C, 2nd Edition, Oxford University Press, New Delhi India, 2014.

Reference Books:

1. Samanta Debasis., Classic Data Structures, 2nd Edition, Prentice Hall of India, New Delhi, India, 2012.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed., Fundamentals of Data Structure in C, 2nd Edition, University Press, India, 2008.

Course Structure

A8403 - Electronic Devices and Circuits

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	2	40	60	100

1. Course Description

Course Overview

This course covers fundamental topics that are common to a wide variety of electronic devices and circuits. The topics include right from the inception of evolution of semiconductor devices to their real time applications. This course starts with the structure of various semiconductor devices like PN junction diode, BJT, JFET, and MOSFET, review their operation and characteristics. This course provides a basis for students to continue education by undertaking advanced study and research in the variety of different branches of semiconductor devices and applications.

Course Pre/co-requisites

A8006 – Applied Physics

A8204 – Basic Electrical Engineering

2. Course Outcomes (COs)

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

A8403.1. Demonstrate the operation and characteristics of diodes and bipolar transistors under various biasing conditions.

A8403.2. Make use of rectifier, filter, and regulator circuits to design DC regulated power supply.

A8403.3. Analyze biasing circuits for stable operation of transistors.

A8403.4. Illustrate the operation and characteristics of JFET and MOSFET under various conditions.

A8403.5. Analyze single stage transistor amplifier circuits using low frequency h-parameter model.

3. Course Syllabus

Diode Characteristics: Current-voltage characteristics of PN-junction diode and Zener diode, diode models. Simple Diode Circuits: Rectifier circuits with and without shunt capacitor filter, Zener diode as voltage regulator, varactor diode.

Bipolar Junction Transistor (BJT): Structure, principle of operation, current components, transistor configurations, input and output characteristics, hybrid parameter calculations from static characteristics.

BJT Biasing: DC analysis - Need for biasing, load line, operating point, biasing and stabilization techniques.

Field Effect Transistor (FET): Junction Field Effect Transistor (JFET) - Structure, principle of operation and characteristics. Metal Oxide Semiconductor Field-Effect Transistor (MOSFET) : Structure principle of operation and characteristics.

Transistor Amplifiers: Transistor as an amplifier, h-parameter model, analysis of transistor amplifier circuit (CE, CB, CC) using h-parameter model, simplified CE h-parameter model.

4. Books and Materials

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, PHI, 2013
2. Millman and Halkias, Electronic Devices and Circuits, 2nd Edition, Tata Mc Graw Hill, 2008

Reference Books:

1. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, 6th Edition, Oxford Series.
2. Jacob Millman, Arvin Grabel (2003), Microelectronics, 2 nd edition, Tata McGraw Hill, New Delhi

Course Structure

A8009 - Engineering Chemistry Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The Chemistry Laboratory conducts fundamental studies of highway materials to understand mechanisms. It provides students with a practical approach towards the various techniques used in engineering application. Practical awareness is inculcated and students are trained both quantitatively and qualitatively during the lab sessions to enhance their understanding and problem solving abilities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8009.1. Apply the instrumental techniques to find out the concentrations or equivalence points of solutions.

A8009.2. Analyze the impurities present in the water using volumetric analysis.

A8009.3. Make use of different titrations to measure various properties of chemical species.

A8009.4. Analyze the importance of temperature and pressure on physical properties like viscosity and surface tension of liquids.

A8009.5. Calculate the yield of synthetic drugs by maintaining specific reaction conditions.

3. List of Experiments

1. Estimation of amount of ferrous ion in a given solution by permanganometry.
2. Estimation of amount of ferrous ion in given solution by dichrometry.
3. Estimation of hardness of water by complexometry using EDTA.
4. Determination of chloride content in water by argentometry.
5. Estimation of amount of hydrochloric acid in a given sample by conductometry.
6. Estimation of amount of acetic acid in a given sample by conductometry.

7. Estimation of amount of hydrochloric acid in a given sample by potentiometry.
8. Estimation of amount of Fe^{+2} in a given sample by potentiometry.
9. Estimation of Mn^{+2} in a given sample by colorimetry.
10. Estimation of Cu^{+2} in a given sample by colorimetry.
11. Determination of viscosity of a given fluid by Ostwald's viscometer.
12. Determination of surface tension of a given liquid by using stalagmometer.
13. Preparation of Aspirin.
14. Preparation of Nylon 6

4. Laboratory Equipment/Software/Tools Required

1. Digital Conductometer
2. Digital Potentiometer
3. Digital Colorimeter
4. Electrical Water Heater
5. Wall Mount Distillation Plant
6. Analytical/Digital Weighing Balance
7. Ostwald's Viscometer
8. Stalagmometer
9. Stopwatch
10. Thermometer
11. RB Flask condenser
12. Magnetic Stirrer
13. Pipette
14. Burette
15. Beaker

5. Books and Materials

Text Books:

1. Ramadevi. B and Aparna. P, Lab manual for Engineering chemistry, S Chand Publications, New Delhi, 2022.

Reference Books:

1. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications.
2. Ahluwalia. V.K, College Practical Chemistry, Narosa Publications Ltd. New Delhi, 2007.

Course Structure

A8011 - English Language and Communication Skills Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is designed to cater to the needs of students in developing their oral communication skills. It begins with an introduction to Phonetics to make them understand the received pronunciation and to help them speak with neutral accent and appropriate intonation. This course incorporates listening skills and draws exercises of listening comprehension from various general and business contexts. The speaking exercises in this course will help the students to present their ideas in different situations, besides helping them to develop team spirit by participating in pair/ group activities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8011.1. Acquire the received pronunciation and speak in a neutral accent.
A8011.2. Use contextual vocabulary for lucid spoken communication.
A8011.3. Comprehend accent of different varieties of English.
A8011.4. Develop skills for professional presentations.
A8011.5. Demonstrate the ability to communicate by enhancing listening skills

3. Course Syllabus

CALL Lab: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening; Introduction to Phonetics – Speech Sounds – Vowels and Consonants

ICS Lab: Spoken vs. Written language- Formal and Informal English; Ice-Breaking Activity and JAM Session- Self Introduction, Importance of Non Verbal Communication; Situational Dialogues: Introducing Others – Greetings – Taking Leave.

CALL Lab: Past Tense and Plural Marker Rules, Structure of Syllables; Listening to Monologues and Dialogues

ICS Lab: Pair Activity: Asking and giving directions; Exchanging information, Making Requests and Seeking Permissions and Justifying Opinions.

CALL Lab: Stress pattern in sentences; Weak and Strong Forms; Neutralization of Mother Tongue Interference; Listening to Group Conversation
ICS Lab: Describing Place, Person and Event

CALL Lab: Intonation; Listening for Specific Information
ICS Lab: Group activity: Agreeing and/or disagreeing, Suggesting, Speculating, Comparing and contrasting; Telephone Etiquette; Introduction to Group Discussion

CALL Lab: Differences between British and American Pronunciation; Listening for General Comprehension of the Content
ICS Lab: Introduction to Interview Skills; Mock Interviews; Structured Presentations; Extempore Presentations

4. Books and Materials

Reference Books:

1. Brook-Hart, Guy, Cambridge English Business Benchmark- Upper Intermediate Business Vantage (with CD), 2nd Edition, South Asian Edition, Cambridge University Press, 2019.
2. Hancock, M., English Pronunciation in Use Intermediate, Cambridge University Press. Print, Cambridge, 2009.
3. Mohanraj, J., Let Us Hear Them Speak, 1st Edition, Sage Texts Print, New Delhi, 2015
4. Exercises in Spoken English, Parts I-III CIEFL, Oxford University Press, 1997.

Course Structure

A8507 - Data Structures Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Data Structures laboratory course provides implementation of linear and nonlinear data structures to organize data efficiently. Data structures are important as they are implemented in every software application. This course covers various operations on Singly Linked Lists and Doubly Linked Lists. The linear and nonlinear data structures are implemented using both arrays and linked lists. The course will also enable the use of appropriate searching and sorting method in handling collection of elements. The course is basis for data structures implementation in various programming languages.

Course Pre/co-requisites

A8501 – Problem Solving through C

A8502 – Problem Solving through C Laboratory

2. Course Outcomes (COs)

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

A8507.1. Implement various searching and sorting techniques on a given data.
A8507.2. Organize data efficiently using linked lists.
A8507.3. Perform various operations on data structures using arrays and linked lists.
A8507.4. Write programs to traverse tree using linked list.

3. List of Experiments

1. Write a C Program to Implement Linear Search and Binary Search.
2. Write a C Program to Implement Bubble Sort and Selection Sort.
3. Write a C Program to Implement Insertion Sort and Quick Sort.
4. Write a C Program to Implement Merge Sort.
5. a) Write a C program to Read an array of integers whose size will be specified interactively at rum time and print those elements.
   b) Write a C program to Illustrate Self Referential Structures.
6. Write a C program to implement Singly Linked List Operations: Creation, Insertion, Deletion, Reverse, Count and Traversal.

7. Write a C program to implement Doubly Linked List Operations: Creation, Insertion, Deletion, Count and Traversal.
8. Write a C program to implement Stack operations using Arrays.
9. Write a C program to implement Stack operations using Linked List
10. a) Write a C Program to implement to convert an expression from Infix to Postfix.
    b) Write a C Program to Evaluate arithmetic expression.
11. a) Write a C program to implement Queue operations using Arrays.
    b) Write a C program to implement Queue operations using Linked List.
12. Write a C program to implement Circular Queue operations using Arrays.

13. Write a C program to implement Deque operations using Arrays.
14. Write a C Program to Implement Traversals on Binary Tree using linked list.

4. Laboratory Equipment/Software/Tools Required

1. Computer Systems (PCs) installed with Ubuntu OS (Open Source/ Freeware)
2. GCC Compiler (Open source / Freeware).

Course Structure

A8404 - Electronic Devices and Circuits Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This laboratory covers verification of operation and characteristics of various electronic devices and circuits. The laboratory includes the software and hardware verification of semiconductor devices. This verifies the operation of various semiconductor devices like PN junction diode, BJT, JFET, and MOSFET, and plot the characteristics. This laboratory provides a basis for students to continue gaining the practical knowledge of different semiconductor devices and their applications practically.

Course Pre/co-requisites

A8007 – Applied Physics Laboratory

A8205 – Basic Electrical Engineering Laboratory

2. Course Outcomes (COs)

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

A8404.1. Analyze the operation and characteristics of electronic devices.

A8404.2. Build electronic circuits making use of diodes and transistors and verify the operation practically.

A8404.3. Analyze rectifier and filter circuits and compute its characteristics.

A8404.4. Design and verify the amplifier circuits for given specifications and plot the frequency response.

A8404.5. Analyze the electrical properties of MOS devices practically and plot the transfer and drain characteristics.

3. List of Experiments

1. Analyze the characteristics of PN junction diode under forward and reverse bias conditions and compute its cut-in voltage, dynamic forward, and reverse resistances.
2. Analyze how the zener diode acts as voltage regulator.
3. Analyze the operation of halfwave rectifier with and without filter and compute its characteristics
4. Analyze the operation of fullwave rectifier circuits with and without filter and compute its characteristics

5. Analyze the input and output characteristics of common base configuration.
6. Analyze the input and output characteristics of common emitter configuration.
7. Calculate the stability factor for different biasing techniques.
8. Design CE amplifier and calculate its bandwidth.
9. Obtain JFET characteristics and calculate JFET parameters.
10. Obtain MOSFET characteristics and calculate MOSFET parameters.

4. Laboratory Equipment/Software/Tools Required

1. Cathode Ray Oscilloscope
2. Function Generator
3. Regulated Power Supply
4. DC Voltmeter and Ammeter
5. Multimeter
6. Discrete Electronic Devices (PN-junction diode, Zener diode, BJT and FET)
7. Circuit Simulator Software (Multisim/LTSpice or any other equivalent)

Course Structure

A8302 - Computer Aided Drawing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course covers the essential core topics for working with the AutoCAD software, orthographic projections for points, lines, planes and solids in different positions, the development of lateral surfaces and the isometric projections. The students are able to create simple solid models of various domain applications.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8302.1. Illustrate various menu bars and tool bars on AutoCAD interface.
A8302.2. Differentiate first angle and Third angle projection system based on representation of orthographic views.
A8302.3. Create orthographic views of points, lines, planes and solids using appropriate tools.
A8302.4. Develop the lateral surface areas of regular solids by construction methods.
A8302.5. Model 3-dimentional views of simple objects using isometric coordinates.

3. Course Syllabus

Introduction to AutoCAD: File menu of AutoCAD with New, Open, Save, Save as and Close, Basic 2D commands like Line, Circle, Ellipse, Multi Line, Construction Line, Polyline, Point, Donut, Ellipse, Polygon, Rectangle, Arc, Erase, Snap, Redraw, Regenerate, Zoom, Pan.

Editing of AutoCAD Drawing: Modify Properties of Drawing Entity, Copy, Move, Rotate, Mirror, Offset, Array, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer, Fillet.

Orthographic Projections-I: Orthographic projections of Points, Lines and planes inclined to one plane and inclined to both the principal planes.

Orthographic Projections-II: Orthographic projections of regular solids-prism, cylinder, pyramid and cone inclined to one of the reference plane.

Isometric Projections: Isometric coordinates, Isometric Scale, Isometric Views of Lines, Planes and solids. Conversion of Isometric View to Orthographic Views and Vice-versa.

4. Laboratory Equipment/Software/Tools Required

1. PC installed with operating system (Windows)
2. Auto CAD software

5. Books and Materials

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2019.
2. K. Balaveera Reddy et al, "Computer Aided Engineering Drawing",2nd Edition,CBS Publications, 2015.

Reference Books:

1. Narayana, K.L. & P Kannaiah, "Text book on Engineering Drawing" , 3rd Edition, Sci-Tech Publishers, 2020.
2. Basant Agrawal B. and Agrawal C. M., "Engineering Graphics", 3rd Edition, TMH Publication, 2020.
3. Shah, M.B., Rana B.C., "Engineering Drawing and Computer Graphics", 2nd Edition, Pearson Education,2009.

Course Structure

A8022 - Engineering Exploration

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This Course provides an opportunity for freshman students to learn in new ecosystem and is one of the unique outcomes of innovative education ecosystem in digital era of our nation. The focus of this course is on Engineering Design Process, Problem Solving, Multi-disciplinary skills, Ethics and Data Acquisition and Analysis. This course is co-designed and co-taught by faculty members drawn from multiple engineering disciplines; it follows Project Based Learning (PBL) pedagogy with need statements covering broad themes of environmental, educational, smart appliances, smart agriculture, industrial needs etc. are used by students to carve out problem definitions by linking Sustainable Development Goals defined by United Nation. Students work in teams to solve identified problems and serves as a platform for peer learning and push students in Multi-disciplinary design thinking in first year itself.

Course Pre/co-requisites

A8021 - Social Innovation

2. Course Outcomes (COs)

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

A8022.1 Compare and contrast the contributions of different types of engineers in the development of a product, process, or system.

A8022.2 Apply the common engineering design process to solve complex problems and arrive at viable solution.

A8022.3 Explore various contemporary software and hardware tools to provide solutions for the problems.

A8022.4 Apply skills needed for successful teamwork including the basics of project management and written and oral communication.

A8022.5 Identify the key elements of professional codes of ethics as well as the ethical and societal issues related to the disciplines and their impact on society and the world.

3. Course Syllabus

Introduction to Engineering and Engineering Study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, Expectation for the 21st century engineer and Graduate Attributes.

Engineering Design Process: Design Cycle, Multidisciplinary facet of design, Importance of analysis in engineering design, general analysis procedure, generation of multiple solution, decision matrix, Concepts of reverse engineering and general mechatronics system.

Introduction to Open-source Platforms: Open-source hardware & software tools, Development (Arduino) of Programming (Tinker CAD Tools) and its Essentials, Introduction to Sensors, Transducers and Actuators and its Interfacing with Open-Source H/W & S/W tools.

Engineering Ethics: Identifying Engineering as a Profession, Significance of Professional Ethics, Code of Conduct for Engineers. Sustainability: Introduction to sustainability, Sustainability leadership, Life cycle assessment.

Project Management & Tools: Introduction, Significance of teamwork, Importance of communication in engineering profession, Checklist, Timeline, Gantt Chart, Significance of documentation.

4. Laboratory Equipment/Software/Tools Required

1. Open-source Hardware: Microchip ATmega328P (UNO/NANO/MEGA).
2. I/O Peripherals: LCD, Keypad, DC/Servo Motor, Switch, 7-Segment LED modules, GSM, GPS etc.
3. Sensor Tool Kit:Digital RED/WHITE/GREEN/BLUE Light Module, IR, Analog Sound, Soil Moisture, LM35 Analog Linear Temperature, MQ7 Analog Carbon Monoxide etc.
4. Open-source Software: Arduino IDE Version 1.8.5.

5. Books and Materials

Text Books:

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, Exploring Engineering: An Introduction to Engineering and Design, Academic Press, 3rd Edition, 2012.
2. Byron Francis, Arduino: The Complete Beginner's Guide, Create space Independent Publishers, 2016.

3. M. Govindarajan, S. Natarajan & V. S. Senthil Kumar, Engineering Ethics, 1st Edition, Phi Learning, 2009.

Reference Books:

1. Neerparaj Rai, Arduino Projects for Engineers, 1st Edition, BPB Publications, 2016.
2. Simon Monk, Programming Arduino: Getting Started with Sketches, 2nd Edition, McGraw-Hill Education, 2016.
3. W. Richard Bowen, Engineering Ethics – Outline of an aspirational approach, Springer London.

II YEAR I SEMESTER

Course Structure

A8004 - Numerical Methods and Complex Variables

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. This course covers numerical methods to evaluate roots of algebraic and transcendental equations, find missing data values by interpolating, and perform numerical differentiation and integration, calculus of functions of single complex variable, mappings in the complex plane, region of convergence of a power series and theory of residues. In addition, this course can be applied in many areas of engineering such as circuit theory, signal analysis and control theory.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8004.1. Apply appropriate Numerical method to approximate a root of an equation.

A8004.2. Identify suitable Numerical method to approximate the values of the function at given intermediate points.

A8004.3. Test for analyticity of complex functions in the given domain.

A8004.4. Build analytic function in series of complex terms.

A8004.5. Evaluate real and complex integrals along a contour.

3. Course Syllabus

Solution of Algebraic and Transcendental Equations: Bisection method, Regula-falsi method, Fixed point iteration method and Newton-Raphson method. Jacobi and Gauss-Seidel iteration Methods for solving linear systems of equations. Finite Differences: Forward differences, backward differences, symbolic relations and separation of symbols, Interpolation using Newton's forward and backward difference formulae and Lagrange's method of interpolation.

Numerical Integration: Trapezoidal rule, Simpson's $\frac{1}{3}$rd -rule and Simpson's $\frac{3}{8}$th -rule. **Numerical solution of first order ODE:** Taylor Series, Picard's method, Euler and modified Euler's methods and Runge-Kutta method of fourth order.

Complex Differentiation: Limit, Continuity, differentiability, analyticity and properties, Cauchy-Riemann equations (without proof) in Cartesian and polar coordinates, harmonic and conjugate harmonic functions, Milne-Thomson method to construct analytic function and Conformal mapping and bilinear transformation.

Complex Integration: Line integral in complex plane, Cauchy's integral theorem and Cauchy's integral formula. Complex power series: Taylor's series and Laurent's series. Zeros, singular points and classification of isolated singular points..

Calculus of Residues: Residue, Evaluation of residue by formula and by Laurent series, Residue theorem, Evaluation of real definite integrals of the form:

$$(i)\int_0^{2\pi} f(\cos\theta,\ \sin\theta)\,d\theta \qquad (ii)\int_{-\infty}^{\infty} f(x)\,dx \qquad (iii)\int_{-\infty}^{\infty} e^{imx} f(x)\,dx$$

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4. Books and Materials

Text Books:

1. Grewal, B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Sastry, S.S. Introductory methods of numerical analysis, 4th Edition, PHI, 2005

Reference Books:

1. Jain, M.K., Iyengar, S.R.K and Jain, R.K. Numerical methods for Scientific and Engineering Computations, New Age International publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Churchill, R.V. and Brown, J.W. Complex Variables and Applications, 8th Edition, McGraw Hill Education (India) Pvt Ltd, 2009

Course Structure

A8211 - Network Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Network Analysis is a foundational course designed to deepen students' understanding of electric circuits while honing their analytical skills. The course covers fundamental network theorems and their practical applications in both DC and AC circuits. Additionally, students delve into advanced topics such as self and mutual inductances, series resonance, two-port networks, filters, attenuators, and network transients. Through this course, students will develop proficiency in simplifying and analyzing complex circuits, enabling them to tackle real-world engineering challenges with confidence.

Course Pre/co-requisites

A8204 - Basic Electrical Engineering

2. Course Outcomes (COs)

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

A8211.1. Analyze self and mutual inductance, coefficient of coupling, and dot convention, and series-parallel connections of coupled circuits.
A8211.2. Evaluate AC power parameters and resonance in AC circuits.
A8211.3. Apply network theorems to simplify complex electrical circuits and evaluate two-port network parameters.
A8211.4. Analyze transient response of series RL, RC and RLC circuits.
A8211.5. Analyze and design various types of filters such as low pass, high pass, band pass and band elimination filters and attenuators.

3. Course Syllabus

Magnetic Circuits: Faraday's laws of electromagnetic induction, concept of self and mutual inductance, coefficient of coupling, dot convention, analysis of series and parallel connections of coupled circuits.

Power and Resonance in AC Circuits: Active power, Reactive power, Apparent power, power factor in single phase AC circuits.

Resonance: Resonance for series and parallel circuits, tank circuit, concept of band width

and Q-factor.

Network Theorems and Twoport Parameters: Tellegen's and Reciprocity theorems with DC Excitations. Maximum Power Transfer Theorem with DC & AC Excitations.
Two Port Parameters: Introduction to two port networks, Types of two-port netwroks- Z, Y, ABCD, hybrid parameters.

Transient Analysis: Initial conditions in transient networks, Transient response of R-L, R-C, R-L-C circuits (Series and Parallel) for D.C Excitations, Transient solutions of networks using differential equations.

Filters and Attenuators : Classification of filters, filter networks, classification based on passband and stopband, characteristic impedance in the pass and stopbands, constant-K low pass filter and high pass filter, m-derived filters, band pass filter and band elimination filter.
Attenuators: T-Attenuator, π-Attenuator, Bridged T type Attenuator, Lattice Attenuator.

4. Books and Materials

Text Books:

1. Charles K. Alexander and Matthew N. O. Sadiku, Fundamentals of Electric Circuits, 7th Edition, Tata Mc Graw Hill, New Delhi, 2015
2. DA. Sudhakar, Shyammohan S. Palli, Network Analysis, 4th Edition, Tata Mc Graw Hill, New Delhi, 2018

Reference Books:

1. William Hart Hayt, Jack Ellsworth Kemmerly, Steven M. Durbin (2007), Engineering Circuit Analysis, 8th Edition, McGraw-Hill Higher Education, New Delhi, India, 2018
2. A. Chakrabarthy (2018), Electrical Circuits, 7th Edition, Dhanpat Rai & Sons Publications, New Delhi, 2018.
3. RJ Ryder-Networks, Lines and Fields, 2nd Ed.PHI,1999

Course Structure

A8407 - Electronic Circuit Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course covers topics of the electronic circuits that are used as basic building blocks for various electronic systems. The topics include right from the inception of designing of electronic circuits such as small signal amplifiers, large signal amplifiers, feedback amplifiers, tuned amplifiers and oscillator for building real time applications. It also provides a basis for students to design various electronic circuits as per the requirement of the applications and makes the student to analyze and design electronic systems as per the given specifications.

Course Pre/co-requisites

A8204 – Basic Electrical Engineering

A8403 – Electronic Devices and Circuit

2. Course Outcomes (COs)

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

A8407.1. Design and analyze multistage amplifiers for the given specifications using small signal model.

A8407.2. Apply the concepts of feedback in the design and evaluation of amplifiers and oscillators.

A8407.3. Analyze the performance of high frequency amplifiers using hybrid-π model.

A8407.4. Analyze the performance characteristics of Class A, Class B, Class C and Class AB power amplifiers.

A8407.5. Design and analyze the tuned amplifiers at radio frequencies and compare their frequency responses.

3. Course Syllabus

Multistage Amplifiers: Introduction, classification of amplifiers, types of couplings, Effect of cascading on gain and bandwidth, choice of transistor configuration in a cascade amplifier, Cascade and Cascode amplifiers, Darlington pair amplifier.

Feedback Amplifiers: Concept of Feedback in Amplifiers Feedback, concept and types, general characteristics of negative feedback amplifiers, Negative feedback - Voltage series,

current series, voltage shunt, current shunt. **Oscillators:** Positive feedback - Barkhausen criterion, Construction and analysis of LC, and RC oscillators, crystal oscillator.

Transistor at High Frequency: Hybrid-pi (π) common emitter transistor model, hybrid - π conductances and capacitances, the CE short circuit current gain, current gain with resistive load, gain-bandwidth product.

Power Amplifiers: Introduction, classification of power amplifiers, series fed class A power amplifier, transformer coupled class A power amplifier, class B power amplifier - push pull and complementary symmetry configurations, crossover distortion.

Tuned Amplifiers: Introduction, classification of small signal tuned amplifiers, single tuned, double tuned and Stagger Tuned amplifiers(Qualitative treatment) .

4. Books and Materials

Text Books:

1. Jacob Milliman, Christos C. Halkias, Chetan D. Parikh (2011), Integrated Electronics Analog and Digital Circuits and Systems, 2nd edition, Tata McGraw Hill Education Private Limited, New Delhi.
2. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, 6th Edition, Oxford Series.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky (2006), Electronic Devices and Circuits Theory, 9th edition, Pearson/Prentice Hall, India.
2. Jacob Millman, Arvin Grabel (2003), Microelectronics, 2nd edition, Tata McGraw Hill, New Delhi

Course Structure

A8408 - Signals and Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Signals and Systems is an introductory course that essentially attempts to cover classification, representation of signals, and analysis in the time and frequency domain of systems. It is a foundation course for advanced courses like Communication Systems and Signal Processing and is predominantly valuable for Electronics and Communication Engineering in the undergraduate program. This course provides coherent and comprehensive coverage of signals and systems.

Course Pre/co-requisites

A8001 – Matrices and Calculus

A8002 – Ordinary Differential Equations and Vector Calculus

2. Course Outcomes (COs)

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

A8408.1. Analyze the characteristics of Continuous-time (CT) and Discrete-time (DT)signals and systems.

A8408.2. Analyze the behavior of continuous time and discrete time LTI systems using convolution and transform analysis.

A8408.3. Evaluate the spectral characteristics of continuous time periodic and aperiodic signals using Fourier analysis.

A8408.4. Analyze CT and DT signals using Laplace transform and Z-Transforms with ROC.

A8408.5. Apply the principles of signal analysis to the filtering and sampling process.

3. Course Syllabus

Classification of Signals and Transmission Through LTI Systems: Continuous Time (CT) and Discrete Time (DT) signals, elementary Signals-Unit Step, Impulse, ramp signals, singularity functions, and Operations on Signals, Classification of systems-Discrete Time Systems and Continuous Time Systems, Impulse and step response of LTI System.

Convolution and Correlation of Signals: System analysis by convolution, graphical interpretation of convolution, correlation, Properties of convolution and correlation functions. **Fourier Series:** Trigonometric Fourier series and Exponential Fourier series, the relationship between Trigonometric Fourier series and Exponential Fourier series, Convergence of Fourier series, Symmetry conditions.

Fourier Transforms: Fourier transform (FT), Fourier transform of standard signals, Fourier transforms involving impulse function, Fourier transform of periodic signals, Properties of Fourier transforms, Filter characteristics of LTI system, Distortion less transmission, Hilbert Transform, and its properties.

Laplace Transforms: The Laplace transform (LT), The Region of convergence (ROC)for Laplace transforms, Properties of Laplace transforms, some Laplace transform pairs, Inverse Laplace Transforms, Partial fraction method, The Transfer Function, Analysis and characterization of LTI system using Laplace Transform, Causality and Stability of a System.

Sampling: Sampling of continuous-time signals, Sampling theorem, Reconstruction of signal from its samples, the effect of under sampling- Aliasing. **Z – Transform:** Z transform of standard signals, The Region of Convergence (ROC) for Z - transform and its properties, Properties of Z -transform, Transfer Function of system, Causality and Stability using Z-transform, Inverse Z- Transform.

4. Books and Materials

Text Books:

1. Oppenheim A. V, Willisky, Signals and Systems,2ndEdition, Prentice Hall of India,India, 2009.
2. Simon Haykin, Barry Van Veen, Signals and Systems,2ndEdition John Wiley Sons(ASIA) Pte Ltd, 2007.

Reference Books:

1. Anand Kumar, Signals and Systems,3rdEdition, PHI Learning Pvt. Ltd, 2019
2. B. P. Lathi, Signals, Systems Communications, BS Publications, New Delhi, 2001.

Course Structure

A8409 - Probability Theory and Stochastic Processes

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This is the fundamental course in signal processing and communication engineering. This course provides a foundation in the theory and applications of random signals and an understanding of the mathematical techniques relating to random processes in the areas of signal processing and communications. This course also focuses on the application of statistical techniques to the study of random noise concepts. This course forms the basis for the study of advanced courses like Analog and Digital Communications, Radar Communications, Cellular and Mobile Communications, Digital image processing, Speech processing, Machine Learning and Deep learning.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8409.1. Demonstrate the importance of probability concepts in single and multiple random variables to find their distribution and density functions.
A8409.2. Apply the concepts of operations on single and multiple random variables to solve the communication engineering problems.
A8409.3. Investigate the characteristics of random processes.
A8409.4. Analyze the propagation of random signals in LTI systems.
A8409.5. Apply the concepts of random processes to characterize the random noise.

3. Course Syllabus

Probability and Random Variables: Probability definitions, joint and conditional, probability, Bayes' theorem, independent events, random variable concept, distribution and density functions-properties, vector random variables, joint distribution and joint density functions-properties, conditional distribution and density functions, distribution and density of a sum of random variables, central limit theorem, example random variables: Gaussian, uniform, exponential, Binomial, Poisons, Rayleigh.

Operations on Random Variables: Expectation, moments, moment generating and characteristic functions, jointly Gaussian random variables, properties, transformations of single and multiple random variables.

Random Process - Temporal Characteristics: The random process concept, classification of processes, distribution and density functions, statistical independence, stationarity, time averages and Ergodicity, Autocorrelation functions and its properties, Cross-correlation functions and its properties, covariance functions.

Random Process-Spectral Characteristics: Power density spectrum and its properties, relationship between PSD and ACF, cross-PSD and its properties, relationship between cross-PSD and Cross-correlation function, Some noise definitions, white and colored noise, Noise bandwidth, Band pass, band-limited and Narrow band processes, properties of band-limited processes.

Random Signal Response of Linear Systems: System response-Convolution, mean and mean squared value of system response, autocorrelation function of response, cross correlation functions of input and output, spectral characteristics of system response, modelling of resistive noise source, effective input noise temperature, spot noise figures.

4. Books and Materials

Text Books:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4th Edition, Tata McGraw Hill, New Delhi, India, 2009

Reference Books:

1. Athanasius Papoulis, Unni Krishna Pillai, Probability, Random Variables and Stochastic Processes, Advanced Engineering Mathematics, 4th Edition, Tata McGraw Hill, New Delhi, India, 2002
2. Steven Kay , Intuitive Probability and Random Processes using MATLAB, Springer US, 2006

Course Structure

A8410 - Electronic Circuit Analysis Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This laboratory analyzes and practically verifies the following electronic circuit's functionality such as small signal amplifiers, large signal amplifiers, feedback amplifiers, tuned amplifiers and oscillator for building real time applications. It also provides a basis for students to design various electronic circuits and verify their characteristics practically, as per the given specifications.

Course Pre/co-requisites

A8404 - Electronic Devices and Circuit laboratory

2. Course Outcomes (COs)

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

A8410.1. Design and verify the functionality of amplifiers based on specifications given.
A8410.2. Practically analyze the effect of feedback and cascading in amplifiers.
A8410.3. Verify the theoretical analyses of amplifier circuits using hardware components or in software tool such as Multisim.
A8410.4. Design amplifier and oscillator circuits for a given specifications and plot the frequency response of the amplifiers.
A8410.5. Compare the performance of power amplifiers and tuned amplifiers practically.

3. List of Experiments

1. Design Two stage RC-coupled CE amplifier and plot its frequency response.
2. Design Darlington pair amplifier and plot its frequency response.
3. Design voltage series feedback amplifier and plot its frequency response.
4. Design current shunt feedback amplifier and plot its frequency response.
5. Design RC Phase shift oscillator and observe the effect of variation in R and C on oscillator frequency.
6. Design Wein bridge oscillator and observe the effect of variation in R and C on oscillator frequency.
7. Design Colpitts oscillator and observe the effect of variation of L on oscillator frequency.
8. Design Hartley oscillator and observe the effect of variation of C on oscillator frequency.

9. Compute the efficiency of power amplifiers under various classes of operation (class A, B and AB)
10. Analyze Single Tuned Voltage Amplifier and Plot gain-frequency responce.

4. Laboratory Equipment/Software/Tools Required

1. CRO
2. Function Generator
3. Regulated Power Supply
4. Multimeter
5. Multisim Software
6. Discrete components

Course Structure

A8411 - Basic Simulation Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course provides fundamental knowledge and practical skills in Signals and Systems, utilizing the MATLAB tool for numerical computations and visualization. It covers the analysis of continuous time signals and systems in both the time and frequency domains. Students will explore sampling and reconstruction, which are essential backgrounds for understanding signal processing and communications. The course is structured as a practical learning experience, offering hands-on training with the MATLAB tool.

Course Pre/co-requisites

A8001 – Matrices and Calculus

A8002 – Ordinary Differential Equations and Vector Calculus

2. Course Outcomes (COs)

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

A8411.1. Interpret the concepts of continuous time signals and systems using MATLAB.
A8411.2. Analyze the behavior of continuous time LTI systems using transform analysis and convolution.
A8411.3. Evaluate the spectral characteristics of continuous time-periodic and aperiodic signals using transformation techniques.
A8411.4. Analyze discrete time signals using Z-Transform.
A8411.5. Apply the knowledge of signal analysis for the conversion of CT signal into DT signal using MATLAB.

3. List of Experiments

1. Generation of Standard Signals and Sequences such as Unit Impulse, Unit Step, Ramp, Signum, Square, Triangularpulse, Sinusoidal, Sinc, and Real exponential signals.
2. Perform the operations on the Independent variable of continuous time signals such as Scaling, Shifting, and Folding.
3. Perform the operations on the dependent variable of continuous time signals such as Addition, Subtraction, Multiplication and amplitude scaling.
4. Find the energy, power, even and odd components of a continuous time signal.

5. Verification of linearity and time invariance properties of a given continuos time system.
6. Find the convolution between two continuous time signals.
7. Find the Auto Correlation and Cross-Correlation for continuous time signals.
8. Compute Trigonometric Fourier series and Exponential Fourier series coefficients of a continuous periodic signal.
9. Computation of the Fourier Transform of standard signals and plotting its magnitude and phase spectrum.
10. Find the Laplace Transform and Inverse Laplace Transform of standard signals using symbolic functions.
11. Sampling Theorem Verification.
12. Find the Z- Transform and Inverse Z transform of standard signals using symbolic functions.

4. Laboratory Equipment/Software/Tools Required

1. Simulation Software (MATLAB, Scilab, Octane etc.)

Course Structure

A8412 - Digital Logic Design Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Verilog HDL is an essential course to start career in VLSI design. Verilog HDL language is used for the design of digital integrated circuits. This course provides the knowledge of constructs and conventions. This course describes four levels of abstraction - behavioural, data flow, gate level, and switch level. This course also emphasizes on synthesis and simulation constructs of Verilog HDL. Moreover, the students will get acquainted with cadence digital design tools and other open-source EDA tools.

Course Pre/co-requisites

A8401 – Digital Logic Design

2. Course Outcomes (COs)

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

A8412.1. Build combinational circuits using gate primitives and module instantiation of Verilog HDL.
A8412.2. Construct combinational circuits using data flow modeling of Verilog HDL.
A8412.3. Devolope sequential circuits using behavioural modeling of Verilog HDL.
A8412.4. Implement finita state machines using Verilog HDL.
A8412.5. Design the memory circuits using Verilog HDL.

3. List of Experiments

Introduction to HDL: Hierarchical modeling concepts, lexical conventions, data types, modules and ports, different types of modeling (Gate level, data flow, and behavioral).

Structural Modeling: Gate primitives in Verilog, Module instantiation.

Data Flow Modeling: Expressions, operands and operators, continuous assignment statements.

Behavioral Modelling: Initial and always blocks, procedural statements, conditional, case, and loop statements.

1. Develop Verilog HDL modules for Adders using structural modeling.
2. Develop Verilog HDL modules for Multiplexers using structural modeling.

3. Develop Verilog HDL modules for Decoders using structural modeling.
4. Develop Verilog HDL modules for latches and flip-flops with gate level modeling.
5. Develop Verilog HDL modules for adders and magnitude comparator using data flow modeling.
6. Develop Verilog HDL modules for flip-flops using behavioral modeling.
7. Develop Verilog HDL modules for counters.
8. Develop Verilog HDL modules for shift registers.
9. Develop a Verilog HDL module for sequence detector.
10. Develop a Verilog HDL module for ROM and RAM. .

4. Laboratory Equipment/Software/Tools Required

1. Computer installed with operating system
2. Xilinx ISE/Cadence Digital Design Tools or any other equivalent

Course Structure

A8023 - Engineering Design Thinking

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course links the primary fields of engineering, explores the engineering design process from conceptual design and optimal choice evaluation to prototyping for project construction. It also provides insights into particular design challenges within their specific fields of engineering and enables the learners to apply the knowledge in real time - designing, constructing and testing a prototype (actual physical build) to solve a real-world engineering problems. In extent, this course is an excellent roadmap for the design engineers seeking to broaden their engineering knowledge to design concepts to their current work.

Course Pre/co-requisites

A8021 - Social Innovation

A8022 - Engineering Exploration

2. Course Outcomes (COs)

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

A8023.1. Interpret the problem-solving skills and product design skills.
A8023.2. Apply foundational knowledge of the primary fields of engineering and scientific concepts to find sustainable solution.
A8023.3. Customize the HCD model to the traditional engineering design process.
A8023.4. Inspect the design and assess a prototype that solves real engineering problem.
A8023.5. Expound the solutions for identified problems and document the findings/reflections for further design.

3. Course Syllabus

Introduction & Case Studies: Definition of design, design process, different problem types, characteristics of novice and informed designers, enhance negotiation and iteration in design, Recognized organizations for design and innovation, shopping cart case study, benefits of failure in design.

Human Centered Design: Introduction to HCD (Human Centered Design), HCD as a Mindset, personas and scenarios, best practice working with communities.

Development of Specification and prototyping: Definition of specification, three examples of ways to generate specifications, how to manage specifications, functional de- composition, three kinds of prototypes, how prototypes can be used in the design process,how to use prototypes can be used to elicit input from users.

Ideation, Innovation & Creativity in Design: Con- cept Selection, Interpretation of Creativity and Innovation, Brain storming and expanding the design Space, case study using decision matrix.

Design for Robustness: Review the design, Brainstorm potential failure models, List the potential effects of failure & causes for each failure.

4. Laboratory Equipment/Software/Tools Required

1. Computers installed with operating system

5. Books and Materials

Text Books:

1. William C. Oakes, Les L. Leone, and Craig J. Gunn, Engineering Your Future, Okemos, MI: Great Lakes Press, 2004.
2. Crismond, D., Contrasting strategies of beginning and informed designers: One representation of learning progressions in engineering design, 2007.
3. Ryan Jacoby and Diego Rodrigue, Innovation, Growth, and Getting to Where You Want to Go, Design Management Review, Vol. 18 No. 1, Winter, 2007.
4. G.Pahl and W.Beitz, Engineering design: A systematic approach, Springer 2nd Editon.
5. Dean Nieusma, Seeing Social Power: Technology Design for User Empowerment, Great Lakes Press, 2012
6. Avery, C. M., Teamwork is an Individual Skill: Getting Your Work Done When Sharing Responsibility. San Francisco, CA: Berrett-Koehler Publishers, Inc., 2001.
7. Astin, A. W., & Astin, H. S., Leadership reconsidered: Engaging higher education in social change - Battle Creek, MI: W. K. Kellogg Foundation, 2000.

Reference Books:

1. Ali K.Kamrani, Emad Abouel Nasr, Engineering design and Rapid Prototyping, 2nd Edition, Springer, 2010
2. Ken Hurst, Engineering design principles, Elsevier Science, 2nd Edition, 2005.

Course Structure

A8031 - Gender Sensitization

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Gender Sensitization is a course that introduces students to different dimensions of gender issues. It is one of the basic requirements for the normal development of an individual and primarily highlights the contribution of both the genders in creation and development of a well balanced society. A curriculum-based approach to bring a change is desired to inculcate sensitivity towards issues concerning the relationship between men and women, caste, declining sex ratio, struggles with discrimination, sexual harassment, new forums for justice, eve-teasing, etc., The need for this sensitivity has been felt and realized through times immemorial and in almost all kinds of human existence, across the globe.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8031.1. Interpret gender sensitization and problems of other genders.

A8031.2. Identify the reasons for the female feticide.

A8031.3. Attain a finer grasp of how gender discrimination works in our society and how to counter it.

A8031.4. Develop sensitivity towards sexual and domestic violence.

A8031.5. Recognize gender sensitivity issues through literature and media.

3. Course Syllabus

Understanding Gender: Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men Preparing for Womanhood. Growing up Male. First lessons in Caste.

Gender Roles and Relations: Two or Many? -Struggles with Discrimination-Gender

Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences- Declining Sex Ratio. Demographic Consequences Gender Spectrum: Beyond the Binary.

Gender and Labour: Division and Valuation of Labour-Housework: The Invisible Labor-"My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. -Gender Development Issues-Gender, Governance and Sustainable Development Gender and Human Rights-Gender and Mainstreaming.

Gender - Based Violence: The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No!-Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu". Domestic Violence: Speaking Out: Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for my Life. . . ."

Gender and Culture: Gender and Film-Gender and Electronic Media Gender and Advertisement Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks- The Brave Heart.

4. Books and Materials

Text Books:

1. Towards a World of Equals: A Bilingual Textbook on Gender". Telugu Akademi, Hyderabad, 2015

Additional Resources:

1. www.worldofequals.org.in

Course Structure

A8033 - Universal Human Values 2: Understanding Harmony

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Values are individual beliefs that motivate people to act in one way or the other, it has an inherent worth, and it prepares an individual to adapt in the family, community and society. The basic five Human Values: Love, Peace, Truth, Right Conduct and Non-violence are hidden in every human being; they are our candid attributes. These fundamental human values contain mankind's deepest moral aspirations and form the basis of our lives as individuals and as societies. A didactic system based on human values helps in holistic development of students and it aids to their understanding of true happiness which can only be found within, not in the transient outside world. All objects in the world are subjected to change, however, the ideals, virtues and values established in human hearts remain as a perpetual source of inspiration to the humankind. The course is an overview of human values that are universally accepted and it highlights the need to incorporate these values in students so that they can contribute their service to human race fruitfully. It briefly discusses their role in their family, society and nature and sensitises them towards harmonious living.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8033.1. Analyze the process of self-exploration, right understanding, relationships, natural acceptance for achieving ultimate happiness .
A8033.2. Examine human being as a co-existence of self 'I' and the material 'Body'.
A8033.3. Correlate the universal harmonious order in society, undivided society and from family to world family.
A8033.4. Interpret the harmony in nature, holistic perception at all levels of existence.
A8033.5. Analyze professional competence for augmenting universal human order, ethical human conduct for acceptance of human values.

3. Course Syllabus

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-1; Self-Exploration what is it? –its content and process; 'Natural Acceptance' and Experiential Validation – as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic human aspiration; Right Understanding, Relationship and Physical facility; Understanding Happiness and Prosperity correctly; Method to fulfill the above Human Aspirations; Understanding and living in harmony at different levels.

Understanding harmony in the Human Being- Harmony in Myself!: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body'-happiness and physical facility; Understanding the body as an instrument of 'I"; Understanding the characteristics and activities of 'I' and harmony 'I"; Understanding the harmony of 'I' with the body: Sanyam and health; Correct appraisal of physical needs, meaning of prosperity in detail; Programs to ensure Sanyam and Health.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship: Understanding values in human-human relationship; meaning of justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness: Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust; difference between intention and competence; Understanding the meaning of respect, Difference between respect and differentiation; the other salient values in relationship; Understanding harmony in the society; Visualizing a universal harmonious order in society.

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence: Understanding the harmony in the Nature; Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural Acceptance of Human Values; Definitiveness of Ethical Human Conduct; Basics for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case studies of typical holistic technologies, management models and productive systems; Strategy for transition from the present state to Universal Human Order.

4. Books and Materials

Text Books:

1. Human values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, 1st Edition, Excel Books, New Delhi, 2010.

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A. N. Tripathi, 3rd Edition New age Intl. Publishers, New Delhi, 2019.
3. The Story of My Experiments with Truth- by Mohandas Karamchand Gandhi, 1st Edition, Fingerprint Publishing, 2009.

II YEAR II SEMESTER

Course Structure

A8013 - Business Economics and Financial Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course addresses the concepts, principles and techniques of Business Economics and Financial Analysis. It covers the fundamentals of Business Economics and its various aspects. Financial analysis gives clear idea about concepts and conventions of accounting, accounting procedures like journal, ledger, trial balance, final accounts and interpretation of financial statements through ratios.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8013.1. Examine the types of business and impact of macroeconomic variables on business.

A8013.2. Analyze interrelationship among various economic variables and its impact.

A8013.3. Classify the market structure to decide the fixation of suitable price.

A8013.4. Apply accounting principles & rules for preparing financial statements.

A8013.5. Analyze financial statements to assess financial health of business.

3. Course Syllabus

Introduction to Business and Economics: Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance. **Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply and Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist.

Demand and Supply Analysis: Elasticity of Demand: Elasticity, Types of Elasticity, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of

Demand, Law of Demand. Demand Forecasting: Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function and Law of Supply. .

Production, Cost, Market Structures & Pricing: Production Analysis Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structure: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition. Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis (simple problems).

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts (Simple Problems).

Financial Ratios Analysis: Concept of Ratio Analysis, Importance and Types of Ratios-Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

4. Books and Materials

Text Books:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata Mc –Graw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata Mc Graw Hill Education Pvt. Ltd. 2012.

Reference Books:

1. A.R. Aryasri (2011), Managerial Economics and Financial Analysis, TMH, India.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

Course Structure

A8415 - Analog Electronic Circuits

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Today the growth of any industry depends on electronics to a great extent. This Course deals with mathematical analysis of wave shaping circuits and generation of non-sinusoidal wave forms using multivibrator circuits and their design is covered extensively so that they can be applied in the electronics and communication systems. It also focuses on process of learning about signal condition, signal generation, filtering, timing and control using various IC circuitries. With modern digitization where there is a need to work with digital data, digital to analog and analog to digital converters are needed in connecting physical world to the more sophisticated digital world.

Course Pre/co-requisites

A8403 - Electronic Devices and Circuits.

2. Course Outcomes (COs)

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

A8415.1 Sketch the response of various electronic circuits for given input.
A8415.2 Compare the frequency response of Active and Passive filters.
A8415.3 Analyze the characteristics of Operational Amplifier.
A8415.4 Examine Analog to Digital and Digital to Analog converters for given resolution.
A8415.5 Design Signal Processing and Generation circuits for the given specifications

3. Course Syllabus

Theory

Wave Shaping Circuits: High pass (differentiator) and low pass (integrator) RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs, RL response for step input.

Signal Generators: Design and analysis of fixed bias and self-biased Bistable multivibrator, design and analysis of collector coupled Monostable and Astable multivibrator.

Operational Amplifier and its Applications: Basic information of Op-Amp IC741, ideal Op-Amp, Op-Amp characteristics - DC and AC. Op-Amp Applications – Review of inverting and non-inverting amplifiers, Integrator and differentiator, Summing Amplifier, Instrumentation Amplifiers, Active filters: Low pass, high pass (1st and 2nd order).

Data Converters: Digital to Analog Converters (DAC) - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Analog to Digital converters (ADC) – Flash type, Single slope, successive approximation, dual slope.

Timers & PLL: Introduction to IC 555 timer, description of functional diagram, Monostable and Astable operations, Schmitt trigger, Qualitative approach of PLL, Block diagram, monolithic PLL and applications of PLL.

4. Books and Materials

Text Books:

1. Jacob Millman, Herbert Taub, Mothiki S. Prakash Rao (2008), Pulse, Digital and Switching Waveforms, 3rd edition, Tata McGraw Hill, New Delhi.
2. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India.

Reference Books:

1. Anand Kumar (2005), Pulse and Digital Circuits, Prentice Hall of India, India.
2. Mothiki S. Prakash Rao (2006), Pulse and Digital Circuits, Tata McGraw Hill, India.
3. Sergio Franco (1997), Design with Operational Amplifiers and Analog Integrated Circuits, McGraw Hill, New Delhi.
4. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.

Course Structure

A8416 - Computer Organization and Microprocessors

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course qualitatively and quantitatively examines computer design trade-off and teaches the fundamentals of computer organization including CPU, memory, registers, arithmetic & logic units, control unit and input/output components. This course introduces the architecture and programming model 8086 microprocessor, enabling the students to write efficient programs in assembly level language of 8086. It helps the students to apply the techniques of interfacing peripheral devices to processors.

Course Pre/co-requisites

A8401 - Digital Logic Design

2. Course Outcomes (COs)

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

A8416.1 Analyze the structure of computers to perform register transfer and micro operations.

A8416.2 Design micro programmed control unit and arithmetic & logic unit to perform control and arithmetic operations.

A8416.3 Analyze the functionality of 8086 microprocessor architecture in minimum mode configuration.

A8416.4 Develop assembly language programs using 8086 instruction set for arithmetic, logical and string manipulation.

A8416.5 Construct a fully functional 8086 computer system by interfacing memory and IO devices.

3. Course Syllabus

Theory

Structure of Computers: Computer Functional units, Von-Neumann architecture, Bus structures, Basic Operational Concepts, Software, Performance, Data representation (Fixed and Floating point), Error detecting codes. **Register Transfer and MicroOperations:** Register transfer language, Register transfer, Bus and memory transfers, Arithmetic micro-operations, Logic micro-operations, Shift micro-operations, and Arithmetic logic shift unit.

Micro-Programmed Control: Control memory, Address sequencing, and design of control unit. **Computer Arithmetic:** Addition and Subtraction, Multiplication and Division algorithms, Floating- point arithmetic operation.

Introduction to 8086 Microprocessor: Architecture of 8086 microprocessor, Register organization, 8086 flag register and its functions, addressing modes of 8086, Pin diagram of 8086, Minimum mode system operation, Timing diagram.

Assembly Language Programming: 8086 Instruction Set, Simple programs, Assembly language programs involving logical, branch and call instructions, sorting, evaluation of arithmetic expressions, string manipulation, assembler directives, procedures and macros.

8086 Memory and Digital Interfacing: 8086 addressing and address decoding, interfacing RAM, ROM, EPROM to 8086, 8255 programmable peripheral interface, various modes of operation and interfacing to 8086, interfacing keyboard, interfacing to alphanumeric displays, seven segment LED displays, stepper motor, D/A and A/D converter interfacing.

4. Books and Materials

Text Books:

1. M. Morris Mano, Sixteenth Impression Computer System Architecture, 3rd Edition, Pearson/PHI, India, 2017.
2. Douglas V. Hall , Microprocessors Interface, 2nd Edition, Tata McGraw Hill, New Delhi. 2007

Reference Books:

1. Carl Hamacher, Zvonks Vransic, Safeazaky, Computer Organization, 5th Edition McGraw Hill, New Delhi, 2011 .
2. Walter A. Triebel, Avtar Singh, The 8088 and 8086 Microprocessors, 4th Edition, Prentice Hall of India, New Delhi,2003.

Course Structure

A8417 - Analog Communications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This is the fundamental course in Communication Engineering. This course provides a foundation in the theory and practical aspects of Continuous and Pulse modulation schemes. This course also focuses on the analysis of noise in continuous-wave modulation systems and design aspects of various Transmitter and Receiver circuits. This course forms the basis for the study of advanced courses like Digital Communications, Radar Communications, Cellular and Mobile Communications, Optical Communications, and Data Communications.

Course Pre/co-requisites

A8408 - Signals & Systems

A8409 - Probability Theory and Stochastic Processes

2. Course Outcomes (COs)

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

A8417.1. Analyze the amplitude and angle modulation schemes using the time and frequency domain to calculate performance parameters.

A8417.2. Generate and demodulate amplitude and angle modulation using appropriate methods and techniques.

A8417.3. Analyze the operational efficacy of radio transmitters and receivers to assess communication systems' overall performance and reliability.

A8417.4. Apply Power spectral density principles to evaluate the SNR of analog modulation schemes.

A8417.5. Comprehend various pulse modulation and demodulation techniques to assess limitations in different practical applications.

3. Course Syllabus

Introduction: Elements of a Communication System, Communication Channels and Their Characteristics, need for modulation, Classification of Modulation schemes. **Amplitude Modulations:** Time and frequency domain description of AM, single multi-tone modulations, power relations, Generation and Demodulation of AM waves, Time and frequency domain description of DSBSC wave, Generation and Demodulation of DSBSC waves.

Amplitude Modulations with Suppressed Carrier: SSB modulation, frequency and time domain descriptions, Generation and Demodulation of SSBSC waves, Applications of SSB modulations, Introduction to VSB modulation, Frequency and Time-domain descriptions of VSB wave, Generation and Demodulation of VSB modulated waves, Applications of VSB Modulation, Comparison of various AM schemes, Frequency division multiplexing.

Angle Modulations: Representation of FM and PM Signals, Single tone FM, Spectrum analysis of sinusoidal FM wave, Narrowband FM, Wideband FM, Constant Average Power, Transmission Bandwidth of FM Wave. Generation of FM: Direct and Indirect methods, Demodulation of FM waves: Balanced slope detector, zero crossing detector, PLL, Advantages and Disadvantages of Angle Modulation, Comparison of AM, FM and PM, Applications of FM and PM.

Analog Transmission and Reception: Introduction, Classification of Radio Transmitters, AM Radio Transmitters, Effect of feedback on the performance of AM transmitter, FM Transmitter, frequency stability in FM transmitter, Introduction to Radio Receivers, Receiver characteristics, TRF receiver, Super-heterodyne receiver, Image frequency, AGC, Squelch, FM stereo transmission and reception.

Noise: Introduction to noise, Effect of Noise on a Baseband System, Noise Performance of DSBSC, SSBSC, AM, and FM Systems, Threshold Effect in FM, Pre-emphasis and De-emphasis Filtering for FM, Digital Versus Analog Transmissions. **Analog Pulse Modulations:** Classification of pulse modulation Schemes, Generation & demodulation of PAM, PWM, and PPM waveforms, Time division multiplexing

4. Books and Materials

Text Books:

1. S. S. Haykin, Communication Systems, 2nd Edition, Wiley Eastern, 2008
2. John G. Proakis and Masoud Salehi, Fundamentals of Communication Systems, 2nd Edition, Pearson, 2014.

Reference Books:

1. Taub and Schilling, Principles of Communication Systems, 2nd Edition, McGraw-Hill, 2008
2. T L Singal, Analog and Digital Communications, 1st edition, 1st Tata McGraw-Hill,

Course Structure

A8418 - Electromagnetic Theory and Transmission Lines

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course covers static and dynamic electric and magnetic fields and their interaction, electromagnetic induction, Maxwell's equations, solving these equations for various boundary conditions, qualitative treatment of uniform plane waves and guided waves that enables a student in understanding static and time varying EM fields and EM waves and transmission lines which are of essential importance in modern communications.

Course Pre/co-requisites

A8002 – Ordinary Differential Equations and Vector Calculus

A8004 – Numerical Methods and Complex Variables

2. Course Outcomes (COs)

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

A8418.1. Interpret electric and magnetic field distributions using vector algebra and vector calculus.
A8418.2. Apply the basic laws of Electromagnetics to determine field intensities.
A8418.3. Apply Maxwell's equations to determine boundary conditions across various media.
A8418.4. Analyze EM waves characteristics in different media.
A8418.5. Analyze the characteristics of the lossy, lossless and distortion less Transmission lines for different load conditions.

3. Course Syllabus

Electrostatics: Introduction to Co-ordinate Systems, Coulomb's law, Electric field intensity, Field due to different charge distributions, Electric flux and Flux density, Gauss law and its applications, Electric potential. Maxwell's equations for electrostatic fields, and illustrative problems.

Magneto Statics: Biot-Savarts law, Amperes circuital law and applications, Magnetic flux and magnetic flux density, Maxwell's equations for magneto static fields, magnetic Scalar

and vector potentials.

Time Varying Fields & Maxwells Equations: Faradays law, Inconsistency of Amperes law and displacement current density, Maxwell's equations in differential, integral and word statements. **Boundary Conditions:** Conditions at a boundary surface, dielectric-dielectric and dielectric – conductor interfaces, illustrative problems.

EM Wave Characteristics: Wave motion in free space, perfect, Lossy dielectrics and good conductors, Poynting theorem, Polarization.

Transmission Lines: Equivalent model, parameters, equations, Infinite line concepts, distortion and its condition, Input impedance of open and short circuited transmission lines, reflection coefficient and VSWR, Elementary treatment of Smith chart.

4. Books and Materials

Text Books:

1. Matthew N. O. Sadiku (2008), Elements of Electromagnetics, 4th edition, Oxford University Press, New Delhi

Reference Books:

1. E. C. Jordan, K. G. Balmain (2000), Electromagnetic Waves and Radiating Systems, 2nd edition, Prentice Hall of India, New Delhi.
2. William H. Hayt Jr. John A. Buck (2006), Engineering Electromagnetics, 7th edition, Tata McGraw Hill, India.
3. John. D. Kraus (2007), Electromagnetics, 6th edition, McGraw Hill, New Delhi.
4. Umesh Sinha, Transmission Lines and Networks, Filters and Transmission Lines. Satya Prakashan, New Delhi

Course Structure

A8419 - Analog Electronic Circuits Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This lab course deals with active and passive devices and circuit configurations used for the generation and processing of analog and digital electronics circuits. It focus on learning theoretical concepts necessary in the study of electronic systems, design and analysis of circuits as waveshaping, multivibrators, Opamp and IC based application and data converters. This lab focuses on the practical methods and techniques for the generation of variety of waveforms and applying them to various circuits in real time to study the response.

Course Pre/co-requisites

A8403 - Electronic Devices and Circuits

2. Course Outcomes (COs)

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

A8419.1. Examine the output response of linear and non-linear circuits to realize the applications like High pass RC circuits and Low pass RC circuits.
A8419.2. Analyze the frequency response of Active and Passive filters.
A8419.3. Implement and examine linear and nonlinear applications using operational amplifier.
A8419.4. Design and implement signal generation circuits for the given specifications.
A8419.5. Analyze and illustrate converters that convert data from Analog to Digital and Digital to Analog.

3. List of Experiments

1. High pass RC Circuit as differentiator or Peaking circuit.
2. Low pass RC circuit as Integrator or Triangular wave generator.
3. Design of analog wave shaping circuit for different time constants.
4. Design of Bistable Multivibrator as a Memory element.
5. Design of Monostable Multivibrator as a Pulse Width generator.
6. Design of Astable Multivibrator as a Square Wave generator.
7. Op-Amp as an Amplifier (Inverting, Non-Inverting and Summing).
8. Design of Differentiator and Integrator using Op-Amp.

9. Design and verify the frequency response of 1st and 2nd order Low pass Butterworth filters.
10. Design and verify the frequency response of 1st and 2nd order High pass Butterworth filters
11. Design and analyze Astable and Monostable mode of operation using IC555.
12. Design Schmitt Trigger (Sine to Square wave converter) using IC555.
13. R-2R ladder type Digital to Analog Converter using IC 741.
14. Parallel Comparator type Analog to Digital Converter using Op-amps and 8 to 3 priority encoder.

4. Laboratory Equipment/Software/Tools Required

1. Cathode Ray Oscilloscope
2. Function Generator
3. Regulated Power Supply
4. Multimeters
5. IC 741, IC 555, IC 565
6. Breadboard
7. Basic Active and Passive components (Resistors, Capacitors and Transistors).

Course Structure

A8420 - Computer Organization and Microprocessors Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course provides hands-on experience to understand data representation, register transfer microoperations. It also introduces the architecture and programming model 8086 microprocessor, enabling the students to write efficient programs in assembly level language of 8086. It helps the students to apply the techniques of interfacing peripheral devices to processors.

Course Pre/co-requisites

A8412 - Digital Logic Design Laboratory

2. Course Outcomes (COs)

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

A8420.1. Examine the signed and unsigned Data Representation through Assembly Language Instructions.
A8420.2. Demonstrate the functionality of 8086 microprocessor programming model using an assembler.
A8420.3. Develop an 8086 assembly language program using arithmetic, logical and branch instructions to implement a specific algorithm.
A8420.4. Apply the assembly language programming proficiency to perform string manipulations to assemble and run on host machine.
A8420.5. Integrate hardware and software modules for interfacing external devices to an 8086 microprocessor.

3. List of Experiments

1. Demonstrate Fixed Point Data Representation.
2. Differentiate and demonstrate various Addressing Modes.
3. Perform arithmetic operations (ADD, SUB, MUL, DIV, ADC, SBB) of 8, 16 & 32 - bit operands.
4. Move the content (Block of data transfer) from memory location to other memory location in Intra to Inter segments.
5. Find GCD and Factorial of given operand, ASCII operations and also to authenticate the password of length 3 bytes.

6. Find the sum of a series, squares & cubes of 8-bit or 16 bit numbers in a given array of 5 numbers.
7. Perform code conversion i.e. conversion of unpacked to packed BCD and vice versa.
8. Find the largest and smallest number in an array of data & to arrange a given series of numbers in ascending and descending order.
9. Perform string manipulation operations on the string stored in the memory.
10. Interface 8255 to 8086 and observe the following operations:
    (a) Configure 8255A such that port A and port B as an output ports and blink LEDs connected alternatively. Execute the program at 0000:2000h.
    (b) Configure 8255A such that port A as an output and port B as an input. Execute the program at 0000:2000h.
11. Interface stepper motor to rotate in clock wise and anti-clock wise.
12. Interface elevator controller to demonstrate elevator design.
13. Interface traffic signal controller to demonstrate signal controlling.
14. Interface D/A converter to generate square wave, triangular wave and sine wave.

4. Laboratory Equipment/Software/Tools Required

1. Personal computer with DOSBox.74
2. ESA 8086 trainer kits
3. 8255PPI kits
4. Elevator modules
5. Traffic signal modules
6. Stepper motor modules
7. Digital to Analog Converter

Course Structure

A8421 - Analog Communications Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This is the fundamental course in Communication Engineering. This course provides a foundation in the theory and practical aspects of Continuous and Pulse modulation schemes. This course also focuses on the analysis of noise in continuous-wave modulation systems and design aspects of various Transmitter and Receiver circuits. This course forms the basis for the study of advanced courses like Digital Communications, Radar Communications, Cellular and Mobile Communications, Optical Communications, and Data Communications.

Course Pre/co-requisites

A8408 - Signals & Systems

A8409 - Probability Theory and Stochastic Processes

2. Course Outcomes (COs)

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

A8421.1. Estimate the modulation parameters for Amplitude and Angle modulation techniques using time domain waveforms.

A8421.2. Analyze the waveform characteristics and spectral properties of Suppressed carrier modulation schemes .

A8421.3. Examine the utilization of time division multiplexing (TDM) in pulse modulation techniques for signal transmission and reception.

A8421.4. Design the AGC and squelch circuit for a given input signal strength in receivers.

A8421.5. Evaluate the functionality of the mixer circuits and frequency synthesizer to obtain frequency translation and frequency multiplication.

3. List of Experiments

1. Generation and Demodulation of AM waves
2. Generation and Demodulation of DSBSC wave
3. Generation and Demodulation of SSBSC wave
4. Generation and Demodulation of FM wave
5. Characteristics of Pre-emphasis & De-emphasis

6. Generation and Demodulation of PAM waves
7. Generation and Demodulation of PWM waves
8. Generation and Demodulation of PPM waves
9. Demonstration of TDM scheme
10. AGC characteristics of super heterodyne receiver
11. Analyze the Functionality and Implementation of Squelch Circuits.
12. Mixer circuit Characteristics
13. Generation of multiple frequencies using Frequency synthesizer
14. MATLAB simulation of amplitude and angle modulations

4. Laboratory Equipment/Software/Tools Required

1. CRO
2. Function Generator
3. Regulated Power Supply
4. Multimeter
5. PC with MATLAB Software
6. Trainer Kits

Course Structure

A8527 - Applied Python Programming Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course provides an introduction to python programming language and students are introduced to core programming concepts like data structures, conditionals, loops, variables, and functions. And also this course includes an overview of the various tools available for writing, running Python code on different hardware board. It also provides hands-on coding exercises using commonly used data structures, writing custom functions, and reading and writing to files also it delves deeper into certain essential programming topics.

Course Pre/co-requisites

A8501 – Problem Solving through C

A8502 – Problem Solving through C Laboratory

2. Course Outcomes (COs)

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

A8527.1. Make use of core aspects of programming and features of the Python language.

A8527.2. Apply core programming concepts like data structures, conditionals, loops, variables, and functions of the Python language.

A8527.3. Demonstrate different tools for writing and running Python code on hardware boards.

A8527.4. Design a fully-functional Python programs using standard Python Syntax And Semantics.

A8527.5. Compile errorless code for accessing GPIO pins & Collecting Sensor data with Raspberry Pi.

3. List of Experiments

Cycle - I

1. Downloading and Installing Python and Modules

a) Python 3 on Linux (Follow the instructions given in the URL https://docs.python-guide.org/ starting/install3/linux/)

b) Python 3 on Windows (Follow the instructions given in the URL https://docs.

python.org/3/ using/windows.html (Please remember that Windows installation of Python is harder!))

c) pip3 on Windows and Linux (Install the Python package installer by following the instructions given in the URL https://www.activestate.com/resources/quick-reads/how-to-install-and-use-pip3/)

d) Installing numpy and scipy (You can install any python3 package using the command pip3 install <packagename>)

e) Installing jupyterlab (Install from pip using the command pip install jupyterlab)

2. Introduction to Python 3

a) Printing your biodata on the screen

b) Printing all the primes less than a given number

c) Finding all the factors of a number and show whether it is a perfect number, i.e., the sum of all its factors (excluding the number itself) is equal to the number itself

3. Defining and Using Functions

a) Write a function to read data from a file and display it on the screen

b) Define a boolean function is palindrome(<input>)

c) Write a function collatz(x) which does the following: if x is odd, x = 3x + 1; if x is even, then x = x/2. Return the number of steps it takes for x = 1

4. The package numpy

a) Creating a matrix of given order m x n containing random numbers in the range 1 to 99999

b) Write a program that adds, subtracts and multiplies two matrices. Provide an interface such that, based on the prompt, the function (addition, subtraction, multiplication) should be performed

5. The package scipy and pyplot

a) Finding if two sets of data have the same mean value

b) Plotting data read from a file

c) Fitting a function through a set of data points using polyfit function

d) Plotting a histogram of a given data set

6. The strings package

a) Read text from a file and print the number of lines, words and characters

b) Read text from a file and return a list of all n letter words beginning with a vowel

Cycle - II

1. Installing OS on Raspberry Pi (Follow the instructions given in the URL https://www. raspberrypi. com/documentation/computers/getting-started.html)

a) Installation using PiImager

b) Installation using image file

- Downloading an Image
- Writing the image to an SD card
- using Linux
- using Windows
- Booting up

2. Accessing GPIO pins using Python

a) Installing GPIO Zero library. (First, update your repositories list: sudo apt update, Then install the package for Python 3: sudo apt install python3-gpiozero

b) Blinking an LED connected to one of the GPIO pin

c) Adjusting the brightness of an LED

d) Adjust the brightness of an LED (0 to 100, where 100 means maximum brightness) using the in-built PWM wavelength.

3. Collecting Sensor Data

a) DHT Sensor interface

- Connect the terminals of DHT GPIO pins of Raspberry Pi.
- Import the DHT library using import Adafruit_DHT
- Read sensor data and display it on screen.

4. Laboratory Equipment/Software/Tools Required

1. Python 3 or higher version for Linux & Windows OS
2. Raspbian OS
3. Desktop Computers or Laptops
4. Raspberry Pi Boards
5. LEDS & Switches
6. Potentiometers
7. Analog & Digital Sensors
8. Active & Passive Elements if any

Course Structure

A8024 - Product Realization

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

Making the students socially responsible is the main motto. In this process introducing technological concepts and creating innovating product is carried out for the community. The Product Realization introduces communication with community, planning of product realization, design and development of the product added with skill sets of leadership. This course given an exposure on converting an innovative idea to physical product to meet the need of the community. It improves skill of research paper writing, patent drafting and also developing the skill of preparation of business models.

Course Pre/co-requisites

A8021 - Social Innovation

A8022 - Engineering Exploration

A8023 - Engineering Design Thinking

2. Course Outcomes (COs)

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

A8024.1. Interpret the specifications of product and solve for practical realization.
A8024.2. Analyse the customers mind set and design the product.
A8024.3. Develop Gantt chart to define timeline for product realization.
A8024.4. Conceptualize the terms called product, purchase, production and monitoring of products.
A8024.5. Communicate the process of converting an idea to physical product to the community.

3. Course Syllabus

Theory

Introduction and Planning of Product Realization: Introduction to Product Realization, Need for Product Realization, Product realization process, Case Study of Product Realization for Global Opportunities. Plan and develop the processes needed for product realization, Defining Quality objectives and requirements, establish processes documents.

Needs - verification, validation, monitoring inspection and test activities (inspection nodes) and criteria for product acceptance and record needed. Case study on timeline of Product realization planning (Gantt Chart).

Customer-Related Processes: Product information Enquiries, contracts or order handling Customer feedback including customer complaints, A field survey.

Design and Development: Review verification and validation of each design and development stages, Functional and performance requirements, Information for purchasing, production and service provisions, review and validation, Develop a Design model of the product.

Purchasing, Production and Service Provision: Purchasing information, Vendors evaluation and approval process, Verification of purchased product. Control of production, service provision, validation of processes for production and service provision, Identification and tractability, Customer property and Preservation of product.

Scope of Product Perseverance: Writing proficiency for papers, Patent drafting and development of business model.

Practice

1. Introducing oneself to the steps of Product realization.
2. Case Study to define the necessity.
3. Brainstorming Session on Product Realization in teams.
4. Watching videos on Planning of product realization in real time scenario from R Labs.
5. Verification of the Product specifications which satisfies all the needs.
6. Discussion with Customers about the product and the specifications.
7. Discussion about the finished product and taking feedback.
8. Feedback Analysis and redesign if required.
9. Verification of redesigned product and market study.
10. Discussion on different Purchasing and Services for the product development.
11. Data from the customer for market and feedback of market is acquired.
12. Activity on Observation skills to know how to use one's observation skills in understanding the parameters
13. Brainstorming deliberations on the initial observations and measuring of the product.
14. Familiarization of the respective templates with the help of sample case study.

4. Books and Materials

Text Books:

1. Mileta M Tomovic, Sowping Wang, Product Realization – A Comprehensive Approach, 1st Edition, Spinger, 2009.
2. Stark, John, Product Life Cycle Management, 21st century Paradigm for Product Realisation 2011, Springer.

Reference Books:

1. Verna J. Bowen, Lucy V. Fusco, The Competitive Edge Research Priorities for U.S. Manufacturing, National Academy of Sciences.
2. Renuka Thota, Suren Dwivedi, Implementation of product realization concepts in design and manufacturing courses, University of Louisiana-Lafayette.

Course Structure

A8032 - Environmental Science and Technology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

This course enables the students to engage with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world. This course requires that the students should identify and analyze the natural and human-made environmental problems and evaluate the relative risks associated with these problems. It provides the scope to examine alternative solutions for resolving or preventing them. It is essentially a multidisciplinary approach that brings out an appreciation of our natural world and human impact on its existence and irrigational control measures. Its components include Biology, Geology, Chemistry, Physics, Engineering, Sociology, Health, Anthropology, Economics, Statistics, Computers and Philosophy, engineering technology, Integrating sustainable development into their engineering practice.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8032.1. Illustrate the important components of environment.

A8032.2. Identify global environmental problems to come out with best possible solutions.

A8032.3. Make use of environmental laws & environmental ethics for the protection of forest and wildlife..

A8032.4. Apply to maintain harmonious relation between nature and human being and integrating sustainable development goals into their engineering practice.

A8032.5. Analyse the major environmental effects of exploiting natural resources.

3. Course Syllabus

Fundamentals of Environment and Ecology: The multidisciplinary nature of environmental studies, environmental ethics, Global environmental issues, Planetary boundaries, Fundamentals of ecology - ecosystem definition, structure and functions of ecosystem, food

chain and food web, feedback loops, Ecosystem services.

Natural Resources and Management: Classification of resources: Renewable and Non-renewable re- sources. Forest resources: Uses and over exploitation of forests. Dams and their environmental impacts. Water resources: Use and over utilization of surface and ground water, conflicts over water. Energy resources: Renewable energy resources: solar energy, wind energy and geothermal energy. Food resources: Problems with Chemical fertilizers and pesticides. Biofertilizers (organic farming) and their importance. Bio-geo chemical cycles, Socio-ecological systems

Biodiversity and Its Conservation: Introduction and definition. Genetic diversity, species diversity and ecosystem diversity. Values of biodiversity: Consumptive use, Productive use, Social, Ethical, Aesthetic and Option values. Man-wildlife conflicts. In-situ and Ex-situ conservation of biodiversity, Biodiversity Law.

Environmental Pollution and Control: Definition, causes, effects and control measures of Environmental pollution, Air pollution, water pollution, Soil pollution, solid and hazardous waste management, Noise pollution, E-waste, bio-medical waste, Wastewater treatment and emerging pollutants, Standards for Air and Water.

Concept of sustainable development: Sustainable development goals, Carbon footprints, Net-Zero-Emissions, Montreal protocol a success story, Conference of parties (CoP), IPCC, Kyoto protocol, Environmental Acts, Life cycle analysis, Circular Economy, Sustainable Living, Ecological Engineering- ecological restoration, natural and constructed wetlands, nature-based solutions. Case Studies: Mission Kakatiya, Chipko Movement, Water Man of India (Dr. Rajendra Singh), Watershed management.

4. Books and Materials

Text Books:

1. Anubha Kaushik, C.P. Kaushik. Perspectives in Environmental Studies. 6th Edition, New age international publishers, 2018.
2. M. Anji Reddy. Textbook of Environmental Science and Technology, Revised Edition, BS Publications, 2014.

Reference Books:

1. Erach Bharucha. Textbook of Environmental Studies for Undergraduate Courses, 2nd Edition, Orient BlackSwan Publishers, 2013.
2. Benny Joseph, Environmental studies, 3rd Edition, McGraw Hill Education (India) Private Limited, 2018.

III YEAR I SEMESTER

Course Structure

A8422 - Digital Communications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides complete knowledge of sampling, quantization and encoding to convert the analog signals into digital form. Various analog to digital conversion techniques like PCM and Delta Modulation along with the refined forms like DPCM and ADM are also discussed. In addition to baseband transmission of digital data over the channel, carrier modulation schemes like ASK, FSK, PSK, DPSK and QPSK are analysed. It focuses on source coding techniques like Huffman coding, Shannon fanon coding for reducing redundant data and channel coding techniques such as linear block codes, cyclic codes and convolution codes for error detection and correction.

Course Pre/co-requisites

A8409 – Probability Theory and Stochastic Processes

A8417 – Analog Communications

2. Course Outcomes (COs)

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

A8422.1. Estimate the Signal to Noise ratio of baseband modulation schemes to measure the performance of digital communication system.

A8422.2. Compare digital carrier modulation schemes in terms of bandwidth and probability of error to realize real time digital communication system.

A8422.3. Apply information theory principles to measure channel capacity parameters.

A8422.4. Apply linear block codes to improve the reliability of a communication system.

A8422.5. Make use of convolutional codes to enhance the performance of a communication system.

3. Course Syllabus

Introduction: Elements of a digital communication system, PCM, quantization noise and Signal to Noise Ratio of PCM system, non-uniform quantization, DPCM, DM, Signal to Noise Ratio of DM system, ADM, comparison of PCM and DM systems.

Digital Carrier Modulation Schemes: Introduction to Band pass Transmission, Generation and detection of coherent binary ASK signalling scheme, binary binary FSK signalling scheme, PSK signalling scheme, DPSK, and QPSK. Probability of Error: Optimum receiver, Probability of error calculations for ASK, FSK and PSK, comparison of digital modulation schemes-bandwidth requirements.

Information Theory: Introduction, measure of information, Entropy, Rate of information, Joint entropy and conditional entropy, mutual information, channel capacity. Source Coding: Source coding theorem (Shannon's theorem), Shannon - Fano coding, Huffman coding, efficiency calculations.

Linear Block Codes: Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, single error correcting Hamming codes, Binary cyclic codes, Algebraic structure of cyclic codes, encoding and decoding using (n-k) bit shift register.

Convolutional Codes: Encoding of convolutional codes, time domain approach, transform domain approach. Graphical approach: code tree, trellis and state diagram, maximum likelihood decoding of convolutional codes, sequential decoding of convolutional codes.

4. Books and Materials

Text Books:

1. K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley & Sons, New Delhi, 2018.
2. Simon Haykin, Michael Moher, Communication Systems, 3rd edition, Wiley, New Delhi, 2008.

Reference Books:

1. B. P. Lathi, Zhi Ding (2019), Modern Digital and Analog Communication Systems, 5th Edition, Oxford University Press.
2. Hebert Taub, Donald Schilling, Goutam Saha (2021), Principles of Communication systems, 3rd Edition, TMH Publishing Company Limited, New Delhi

Course Structure

A8423 – Antennas and Wave Propagation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

Antennas and propagation effects play a crucial, even though often overlooked, role in RF systems. In practice, the design of a working system such as mobile phone networks, Wi-Fi, RFID, Satellite communication and GPS requires a good understanding of these components. This course teaches the fundamentals of antenna and propagation and shows the application in practical examples. The course covers the theory of radiation, fundamental antenna parameters and concepts, wire antennas such as dipoles, loop, Yagi-Uda and Log Periodic antennas, antenna arrays, aperture antennas (e.g. Horns Parabolic Reflector Antennas and Microstrip antennas) for various applications and their numerical analysis. Further different modes of wave propagation of electromagnetic wave will be discussed.

Course Pre/co-requisites

A8418- Electromagnetic Theory and Transmission Lines

2. Course Outcomes (COs)

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

A8423.1. Analyze the parameters influencing antenna performance and evaluate the radiation mechanism in designing and optimizing antenna systems.

A8423.2. Compute the radiation fields and draw the patterns of an antenna array to assess the suitability for a given application.

A8423.3. Demonstrate proficiency in the design of Wire antennas optimized for VHF/UHF applications.

A8423.4. Design and optimize Aperture antennas tailored to specific Microwave applications.

A8423.5. Choose an appropriate wave propagation mode for establishing communication link between two points.

3. Course Syllabus

Antenna Basics: Introduction, Radiation Mechanism -Basic Antenna Parameters, Qualitative treatment of Short dipole, Half wave dipole -Field, Current pattern, Power Radiated, Radiation resistance, Effective aperture and Directivity, Related Problems.

Antenna Arrays: Two element arrays, Multiplication of patterns, Linear Array with n -isotropic point sources of equal amplitude and spacing (Broadside, End fire Arrays), EFA with Increased Directivity, Binomial Array, Related Problems.

Wire Antennas: Loop Antenna, Yagi Uda Antenna, Helical Antenna - Geometry, Helix modes, Log Periodic Antenna.

Aperture Antennas and Antenna Measurements: Horn Antenna, Paraboloidal Reflectors – Feed systems. Microstrip Antennas: Features, Feed types, Design. Antenna Measurements: Pattern measurement - Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods).

Wave Propagation: Introduction, Modes of Propagation, Ground Wave Propagation, Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, Virtual Height, MUF– Calculations, LUHF, Skip Distance, Optimum working Frequency, Space Wave Propagation – LOS, Duct propagation, Fading , Diversity techniques.

4. Books and Materials

Text Books:

1. Kraus, John D., Ronald J. Marhefka, and Ahmad Khan. Antennas and Wave Propagation. New Delhi: Tata McGraw Hill Education, 2011.
2. Balanis, Constantine A. Antenna theory: analysis and design. Wiley-Inter science, 2005.

Reference Books:

1. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
2. K. D. Prasad, Satya Prakashan, Antennas and Wave Propagation, Tech India Publications, New Delhi.
3. Edward C. Jordon , Keith G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition, Pearson Edition

Course Structure

A8424 – Control Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

This course deals the modeling of linear systems and using feedback to improve their performance. The progression of topics in the course includes differences between openloop and closed-loop control systems, use of feedback to improve tracking, mitigate the effects of unwanted signals (disturbances), and render a system less sensitive to changes in system parameters. PID controllers and stability testing with Root Locus and the Nyquist criterion. It also focuses on state-space design to demonstrate the applicability of linear algebra methods to characterize system response and lead to the use of state feedback for system stabilization or control.

Course Pre/co-requisites

A8002 Ordinary Differential Equations and Vector Calculus

2. Course Outcomes (COs)

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

A8424.1. Analyze and simplify open-loop and closed-loop transfer functions using block diagram reduction methods, signal flow graphs, and Mason's gain formula.

A8424.2. Apply the principles of time response analysis in control systems to evaluate systems with first and second-order dynamics..

A8424.3. Analyze control system stability using Routh's criterion and evaluate the effects of adding poles and zeros to G(s)H(s) through root locus analysis

A8424.4. Analyze frequency domain specifications using Bode diagrams, and assess system stability through phase margin, gain margin, Polar plots, and Nyquist plots.

A8424.5. Apply compensation techniques and PID controllers to improve control system performance, and interpret state space representations.

3. Course Syllabus

Basics in Control System and Transfer Function: Introduction of Control Systems, Various types of systems (Open Loop and closed loop) and their differences, Feed-Back Characteristics of control system-Effects of feedback. Mathematical Models: Differential

equations, representation of transfer function: Block diagram representation of systems considering electrical systems as examples. Block diagram reduction techniques, Signal Flow Graph representation, Reduction using Mason's gain formula.

Time Response Analysis: Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants.

Stability Analysis: The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s)H(s) on the root loci.

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots. Stability Analysis: Polar Plots, Nyquist Plots-Stability Analysis.

Compensators and Controllers: Compensation techniques – Lag, Lead, Lead-Lag Compensators, PID Controllers. State Space Analysis: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization-Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

4. Books and Materials

Text Books:

1. I. J.Nagrath, M.Gopal (2012), Control Systems Engineering, 5^{th} Edition, New Age International Publishers, New Delhi, India.

Reference Books:

1. K. Ogata (2013), Modern Control Engineering, 4th edition, Prentice Hall of India Pvt. Ltd, New Delhi.
2. N. K. Sinha (2013), Control Systems, 3^{rd} edition, New Age International Limited Publishers, New Delhi

Course Structure

A8425 – Microcontrollers

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	1	0	45	15	0	4	40	60	100

1. Course Description

Course Overview

The microcontrollers are the main building block in many applications like automation of homes, offices, cars, factories, hospitals and popularly in consumer electronics. The huge numbers of applications and complexity lead to unique design approaches, one among that emphasizing on using high-level tools with hardware/software tradeoffs rather than low-level assembly-language programming and logic design. This course presents the traditionally distinct controllers used in industrial systems with low- and high-level programming language. It covers microcontrollers 8051 controller and ARM cortex processor specifications, programming and I/O interfacing. The course is accompanied with laboratory experiments directly linked to the theoretical concepts with hands-on learning.

Course Pre/co-requisites

A8416 - Computer Organization and Microprocessors.

2. Course Outcomes (COs)

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

A8425.1. Analyze features of Intel 8051 microcontroller and ARM cortex processor to use it for desired applications.

A8425.2. Develop embedded C programs of 8051 microcontroller and ARM cortex processor.

A8425.3. Interface peripheral devices to Intel 8051 microcontroller and ARM cortex processor to realize practical applications.

A8425.4. Interface memory and IO devices to Intel 8051 microcontroller and ARM cortex processor to make it a functional model.

A8425.5. Analyze interrupt structure of Intel 8051 microcontroller and ARM cortex processor for the execution of interrupt request.

3. Course Syllabus

The 8051 Architecture: Introduction, 8051 micro controller hardware, register organization, internal RAM organization, addressing modes, interrupt structure and external memory interfacing.

8051 Programming in Assembly and Embedded 'C' language: Instruction set, Simple programs, bit manipulation and I/O port programming, timer/counter programming with and without Interrupts, serial communication and serial interrupt programming.

I/O Interfaces and its Driver Mechanisms: Seven segment display (CMOS 4511 or TTL 7447), DC motor (L293D), Stepper motor ULN2003, ADC0808/0809, DAC0800, Keypad and Alphanumeric Displays (LCD) interfacing with 8051.

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

Advanced ARM Processors: Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

4. Books and Materials

Text Books:

1. M. A. Mazidi J. G. Mazidi, Rolin D. McKinlay (2000), The 8051 Microcontroller and Embedded System, Prentice Hall of India, New Delhi.
2. Andrew N SLOSS, Dominic SYMES, Chris WRIGHT -ARM System Developers guide, Elsevier, 2012

Reference Books:

1. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, India, 2008.
2. Ajay V. Deshmukh, Microcontrollers Theory and applications, Tata McGraw Hill Edition, New Delhi, 2004.
3. Raj Kamal, Embedded Systems - Architecture, Programming and Design, 3rd Edition, McGraw Hill Education India, 2017.

Course Structure

A8426 - Digital Communications Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The essence of any communication system is the generation and reliable detection of signals which carry information over a noisy channel with bandwidth and power limitations. This course gives deep knowledge to solve practical problems in the area of communications using hardware equipment and MATLAB environment. This course helps the students to implement and simulate signal digitization of analog signals and their reconstruction into analog form, shift keying methods and channel encoding methods.

Course Pre/co-requisites

A8420 – Analog Communications Laboratory

2. Course Outcomes (COs)

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

A8426.1. Analyze the performance of analog to digital conversion schemes.
A8426.2. Implement bandpass modulation schemes for a given input data.
A8426.3. Analyze the generation and detection of digital modulation schemes using different sources.
A8426.4. Develop digital modulation methods to verify the functionality of band pass data transmission.
A8426.5. Implement error control codes to enhance the reliability of a communication system.

3. List of Experiments

PART-A: Testing in Hardware Laboratory (Any 6 Experiments)

1. Pulse Code Modulation and Demodulation.
2. Differential Pulse Code Modulation and Demodulation.
3. Delta modulation and Demodulation.
4. Amplitude Shift Keying Modulation and Demodulation.
5. Frequency Shift Keying Modulation and Demodulation.
6. Phase Shift Keying Modulation and Demodulation.
7. Differential Phase Shift Keying Modulation and Demodulation.

8. Quadrature Phase Shift Keying Modulation and Demodulation.

PART-B: Simulation using MATLAB/Simulink

A) Any four from hardware laboratory

B) Any two of the following

1. Convolutional coder and decoder.
2. Error detection and correction of Linear block code.
3. Error detection and correction of Cyclic code.
4. Convolutionally decode binary data using VITERBI algorithm.
5. Bit Error Rate performance analysis of BPSK and QPSK modulation techniques.

4. Laboratory Equipment/Software/Tools Required

1. Trainer Kits.
2. Cathode Ray Oscilloscope.
3. Function Generator.
4. Multimeter.
5. MATLAB software.

5. Books and Materials

Text Books:

1. K. Sam Shanmugam (2018), Digital and Analog Communication Systems, John Wiley & Sons, New Delhi.
2. Simon Haykin, Michael Moher (2009), Communication Systems, 5th edition, Wiley, New Delhi.

Reference Books:

1. B. P. Lathi, Zhi Ding (2019), Modern Digital and Analog Communication Systems, 5th Edition, Oxford University Press.
2. Hebert Taub, Donald Schilling, Goutam Saha (2021), Principles of Communication systems, 3rd Edition, TMH Publishing Company Limited, New Delhi

Course Structure

A8427 - Microcontrollers laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The objective of this course is to give hands-on experience on microcontrollers 8051 and ARM cortex processor to the students through basic simulation and interfacing sensors and actuators. This course introduces the compilers Keil, Nano Edge AI studio and Cube IDE to develop the code and debug on the host machine. Students will get complete experience of developing the code and hardware from the scratch.

Course Pre/co-requisites

A8425 – Microcontrollers

2. Course Outcomes (COs)

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

A8427.1. Develop embedded C programs for 8051 microcontroller and ARM cortex processor.
A8427.2. Utilize the Keil C compiler, Nano Edge AI studio and Cube IDE for programming microcontrollers.
A8427.3. Interface peripheral devices to Intel 8051 microcontroller and ARM cortex processor to realize practical applications.
A8427.4. Interface memory and IO devices to Intel 8051 microcontroller and ARM cortex processor to make it a functional model.
A8427.5. Demonstrate interrupt execution of Intel 8051 microcontroller.

3. List of Experiments

Cycle I (8051μC using Keil platform)

1. Assembly language program to perform Arithmetic, Logical, Shift, Rotate and Branch operations.
2. Demonstrate Switch and LED interfacing mechanisms with 8051μC.
3. Generate a square waveform using Timer with and without interrupt.
4. Count number of pulses applied on P3.4 using counter1.
5. Write an Assembly Language program to send and receive serial data using serial port programming with and without interrupt.

6. Interface Seven segment display with 8051 μC
7. Interface 16X2 Liquid Crystal Display (LCD) control characteristics on 8051μC using the appropriate program modes.
8. Interface Stepper motor with 8051μC.
9. Interface DAC with 8051μC.
10. Interface Matrix keypad with 8051μC
11. Interface with 8051μC

Cycle II (STM32(ARM Cortex) using Nano Edge AI studio and Cube IDE)

1. Demonstrate on-board LED and Switch operation.
2. Configure user button press using GPIO interrupts
3. Interface audio sensor to STM32 Nucleo board.
4. Implement a data logger to send data from STM32 to Nano Edge AI studio.

4. Laboratory Equipment/Software/Tools Required

1. A Computer System with Windows 10 Operating System
2. Keil C compiler
3. ESA 8051 boards
4. LEDs and Switches
5. STM32 boards
6. LCD module
7. Seven segment display module
8. Stepper motor and driver
9. DAC module
10. ADC module
11. Keyboard module

5. Books and Materials

Text Books:

1. M. A. Mazidi J. G. Mazidi, Rolin D. McKinlay (2000), The 8051 Microcontroller and Embedded System, Prentice Hall of India, New Delhi.
2. Andrew N SLOSS, Dominic SYMES, Chris WRIGHT -ARM System Developers guide, Elsevier, 2012.

Reference Books:

1. Kenneth J. Ayala (2008), The 8051 Microcontroller, 3rd edition, Cengage Learning, India.
2. Ajay V. Deshmukh (2004), Microcontrollers Theory and applications, Tata McGraw Hill Edition, New Delhi
3. Raj Kamal, Embedded Systems - Architecture, Programming and Design, 3rd Edition,

McGraw Hill Education India, 2017.

Course Structure

A8034 - Indian Constitution

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

This course enables the students to understand the constitution of India as the Supreme law of India. The student will also gain knowledge about the parliament of India and how it functions. This course will survey the basic structure and operative dimensions of the Indian constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian constitution.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8034.1. Identify the important components of Indian Constitution.
A8034.2. Apply the fundamental rights in right way and become a more responsible citizen.
A8034.3. Illustrate the evolution of Indian Constitution.
A8034.4. Identify the basic structure of Indian Constitution.
A8034.5. Relate the basic concepts of democracy, liberty, equality, secular and justice.

3. Course Syllabus

Evolution of Indian constitution: Indian independence act 1947, formation of constituent assembly of India, committees of the constituent assembly, constitution of India drafting committee, brief study about Indian Constitution drafting committee Chairman, time line of formation of the constitution of India.

Structure of the constitution of India: Parts, schedules, appendices, constitution and government, constitution and judiciary.

Preamble to the constitution of India: Brief study about sovereignty, socialist, secularism, democracy, republic, justice (political justice, social justice, economic justice), liberty, equality, fraternity, unity & integrity.

Acts: Salient Features, Provisions of the acts: Right to education act, right to information act, anti-defection law, Jan Lokpal bill.

Fundamental rights: Right to equality, right to freedom (freedom of speech and expression, right to practice any profession etc.), right against exploitation, right to freedom of religion, cultural & education rights, right to property, right to constitutional remedies

4. Books and Materials

Text Books:

1. Dr. Durga das basu.Introduction to the constitution of India, 21st Edition, Lexis Nexis books publication Ltd, 2013.

Reference Books:

1. Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.
2. Arun K Thiruvengadam, The Constitution of India, 1st Edition, Hart publishing India, 2017.

III YEAR II SEMESTER

Course Structure

A8428 - CMOS VLSI Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course lays foundation for the design of digital integrated circuits using CMOS technology. It starts with understanding the physics of MOS transistors, threshold voltage, drain current and other short channel effects. This course covers design and analysis of basic CMOS circuits such as inverters, NAND gate, NOR gate, noise margins, power consumption and delay considerations. The course leverages to learn the design of circuits using CMOS static logic, transmission gate logic, and dynamic logic. The knowledge gained through this course enables the students to take up a course end project using Computer-Aided Design (CAD) tools.

Course Pre/co-requisites

A8403 - Electronics Devices and Circuit.

A8401 - Digital Logic Design

2. Course Outcomes (COs)

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

A8428.1. Analyze the electrical properties and characteristics of MOS devices and circuits.
A8428.2. Analyze the switching characteristics of CMOS inverter.
A8428.3. Construct logic circuits using CMOS static logic.
A8428.4. Construct logic circuits using transmission gate-based logic.
A8428.5. Analyze logic circuits using dynamic and differential logic design styles.

3. Course Syllabus

MOS Transistor Theory: Introduction, MOS device design equations, threshold voltage, body effect, channel length modulation. **CMOS Inverter:** Basic circuit and DC operation-DC characteristics, Noise Margins.

CMOS Inverter Switching Characteristics: Switching intervals, high-to-low time, low-to-high time, maximum switching frequency, RC modeling, propagation delay, inverter

design-DC design, transient design, power dissipation.

CMOS Static Logic: Complex logic functions, CMOS NAND gate, CMOS NOR gate, complex logic gates, exclusive-OR and equivalence gates, adder circuits, SR and D-type latch, the CMOS SRAM cell, Schmitt trigger circuits, tri-state output circuits, pseudo-nMOS logic gates.

Transmission Gate Logic: Basic structure, electrical analysis, RC modeling, TG-based switch logic gates, TG registers, the D-type flip-flop, nFET based storage circuits.

CMOS Dynamic Logic: Charge leakage, charge sharing, the Dynamic RAM cell, precharge / evaluate logic, domino logic, NORA logic, dual rail logic, cascode voltage switch logic (CVSL), Complementary Pass-transistor Logic (CPL), Dual Pass-transistor Logic (DPL). **Advanced Devices:** Introduction to FinFET, CNFET and GNRFET, comparison with CMOS.

4. Books and Materials

Text Books:

1. John .P. Uyemura (2011), CMOS Logic Circuit Design, Springer International Edition, India.

Reference Books:

1. Neil H. E. Weste, Kamran Eshraghian (2001), Principles of CMOS VLSI Design – A System Perspective, 2nd Edition, Pearson Education Asia, India.
2. Kenneth William Martin (2000), Digital Integrated Circuit Design- Oxford University Press.
3. Jerry G. Fossum , Vishal P. Trivedi, Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs – Cambridge University Press, 2013

Course Structure

A8429 – Digital Signal Processing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces fundamental concepts, algorithms and applications of digital signal processing. Starting from a description of how signals can be represented as digital waveforms and how systems may be modelled as digital filters; the course investigates the processing and analysis of signals using the most common approaches and algorithms. The familiarity with the Fourier and Z-transforms and concepts such as linearity and shift invariance is used in the description and analysis of linear discrete systems. Major parts of the course will concentrate on signal analysis using Fourier transforms, linear system analysis, Filter design and its realization.

Course Pre/co-requisites

A8408 – Signals and Systems

2. Course Outcomes (COs)

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

A8429.1. Apply the fundamentals of signals and systems to obtain the response of DT systems.
A8429.2. Analyze Discrete time signals and systems using transform techniques.
A8429.3. Design and implement digital FIR filters for given specifications.
A8429.4. Design and implement digital IIR filters for given specifications.
A8429.5. Design DSP computational building blocks to achieve high speed in DSP processors.

3. Course Syllabus

Introduction to Digital Signal Processing: Overview of Discrete Time Signals, Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems.

Fourier Transforms: Frequency domain representation and analysis of discrete time signals and systems. Discrete Fourier transforms: frequency domain sampling, DFT as a linear

transformation, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relationship of DFT to other transforms, Properties of DFT, linear convolution of sequences using DFT. **Fast Fourier Transforms:** Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

Design of IIR Digital Filters: IIR filter design by Approximation of Derivatives, IIR filter design by impulse invariance, IIR filter design by bilinear transformation, Characteristics of commonly used analog filters (Butterworth and Chebyshev), Frequency transformations, Realization of IIR filters: Direct form structures, cascade form structure, Parallel form structure.

Design of FIR Digital Filters: Symmetric and antisymmetric FIR filters, Frequency response of linear FIR filters, Design of FIR Filters: Fourier Series Method, Windowing techniques, comparison of IIR & FIR filters. Realization of FIR filters: Direct form structure, Cascade form structure and linear phase structure

Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues.

4. Books and Materials

Text Books:

1. John G. Proakis, Dimitris G. Manolakis (2007), Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education / PHI, India.
2. Avtar Singh and S. Srinivasan (2006), Digital Signal Processing, Thomson Publication, India.

Reference Books:

1. M. H. Hayes (2007), Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.
2. Robert J. Schilling, Sandra L. Harris (2007), Fundamentals of Digital Signal Processing using Matlab, Thomson Publications, India.
3. Dimitris G. Manolakis, Vinay Ingle (2011), Applied Digital Signal Processing, Cambridge University Press, Newyork.

Course Structure

A8430 –Microwave Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The Course is intended to provide the foundation for microwave engineering to the UG students. The course will provide an overview of microwave applications in communications and in other areas. In particular, a detailed discussion on microwave frequency ranges and their importance in modern era. This course will also provide the analysis of microwave transmission lines like waveguides (rectangular), various microwave components like T-junctions, circulator, isolator etc. and different microwave sources like Klystron, Magnetron and Gunn diode are discussed in detail to enable the student to design microwave sub-systems and systems. Measurement of various parameters like power, frequency and attenuation will also be covered.

Course Pre/co-requisites

A8418 – Electromagnetic Theory and Transmission Lines

2. Course Outcomes (COs)

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

A8430.1. Apply the knowledge of Electromagnetics and Basic Engineering Mathematics on Microwave comp1nents and sources.
A8430.2. Apply the waveguide mode characteristics to measure the performance of microwave transmission lines and waveguide components.
A8430.3. Analyze various microwave transmission lines, components, sources and validate their performance.
A8430.4. Design the end-to-end Microwave/ RF communication links.
A8430.5. Evaluate the performance of microwave sources and components.

3. Course Syllabus

Microwave Transmission Lines: Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities,

Wavelengths and Impedance Relations Related Problems, Impossibility of TEM mode.

Waveguide Components and Applications: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide windows, Tuning Screws and Posts, Matched Loads. Waveguide Multiport Junctions – E plane and H plane Tees, Magic Tee, Hybrid Ring; 2 hole Directional Couplers. Ferrite Components – Gyrator, Isolator, Circulator. Scattering Matrix– Significance, Formulation and Properties. S Matrix Calculations for 2 - port Junction, E plane and H plane Tees, Magic Tee, Directional Coupler, Circulator and Isolator.

Microwave Tubes: Microwave tubes – O type and M type classifications. O-type tubes: 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process. Reflex Klystrons – Structure, Applegate Diagram and Principle of working (Qualitative treatment). HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (Qualitative treatment).

M-Type Tubes: Introduction, Cross-field effects, Magnetrons – Different Types, 8- Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off and Hartree Conditions (Qualitative treatment). TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation.

Microwave Measurements: Description of Microwave Bench; Microwave Power Measurement – Bolo meters. Measurement of Attenuation, Frequency, Measurement of Low and High VSWR, Impedance Measurements.

4. Books and Materials

Text Books:

1. Samuel Y. Liao (2008), Microwave Devices and Circuits, 3rd edition, Prentice Hall of India, New Delhi.
2. R. E. Collin (2007), Foundations for Microwave Engineering, 2nd edition, IEEE Press, John Wiley, India.
3. M. Kulkarni (2009), Micro Wave and Radar Engineering, Umesh Publications, New Delhi.

Reference Books:

1. M. L. Sisodia, G. S. Raghuvanshi (1995), Microwave Circuits and Passive Devices, Wiley Eastern Ltd., New Age International Publishers Ltd.
2. Peter A. Rizzi (1999), Microwave Engineering Passive Circuits, Prentice Hall of India,

New Delhi.

3. Herbert J. Reich, J. G. Skalnik, P. F. Ordung, H. L. Krauss (2004), Microwave Principles, CB Publishers.

Course Structure

A8431 - CMOS VLSI Design Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is primarily designed for students to learn fundamentals of CMOS digital circuit design through hands on experience. This course enables to design and analyze circuits using CMOS static logic, transmission gate logic and dynamic logic. The knowledge gained through basic experiments using CAD tools enables the students to pursue course end project by defining a problem statement in CMOS VLSI Design.

Course Pre/co-requisites

A8404 – Electronics Devices and Circuits Laboratory

A8412 - Digital Logic Design Laboratory.

2. Course Outcomes (COs)

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

A8431.1. Analyze the DC and transient characteristics of CMOS Inverter.
A8431.2. Construct basic logic gates using CMOS logic.
A8431.3. Design combinational circuit and sequential circuit using CMOS logic.
A8431.4. Design combinational circuit and sequential circuit using transmission gates.
A8431.5. Construct logic circuits using dynamic and differential logic styles.

3. List of Experiments

PART-A: Testing in Hardware Laboratory (Any 6 Experiments)

1. Analyze the DC and transient characteristics of CMOS Inverter.
2. Design of CMOS Logic Gates - NAND, NOR, XOR and XNOR.
3. Design a static CMOS full adder.
4. Design of SR and D-Type latch using CMOS static logic.
5. Design of CMOS SRAM Cell.
6. Analyze the voltage transfer characteristics of Schmitt Trigger.
7. Analyze the characteristics of Pseudo-NMOS inverter.
8. Design a 4-to-1 multiplexer using transmission gates.
9. Design of full adder using transmission gates.

10. Design of D-Type flip-flop using transmission gates.
11. Implementation of clocked CMOS logic gates - NAND and NOR gate.
12. Construct logic circuits using dynamic logic styles.
13. Construct logic circuits using differential logic styles.

4. Laboratory Equipment/Software/Tools Required

1. Computers installed with Linux operating system
2. Cadence Virtuoso Analog Design Environment

5. Books and Materials

Text Books:

1. John .P. Uyemura (2011), CMOS Logic Circuit Design, Springer International Edition, India

Reference Books:

1. Neil H. E. Weste, Kamran Eshraghian (2001), Principles of CMOS VLSI Design – A System Perspective, 2nd Edition, Pearson Education Asia, India.
2. Kenneth William Martin (2000), Digital Integrated Circuit Design- Oxford University Press

Course Structure

A8432 – Digital Signal Processing Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course will give the knowledge in practical abilities of Digital Signal Processing using MATLAB and DSP processors for numerical computations and visualization. This course introduces fundamental concepts, algorithms and applications of digital signal processing. This course investigates the processing and analysis of signals using the most common approaches and algorithms. It provides the necessary background to design and analyze the discrete time system.

Course Pre/co-requisites

A8408 – Signals and Systems

A8411 – Basic Simulation Laboratory

2. Course Outcomes (COs)

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

A8432.1. Interpret the concepts of Discrete time signals and systems using MATLAB.
A8432.2. Analyze Discrete time signals and systems using transform techniques using MATLAB.
A8432.3. Implement digital FIR and IIR filters for the given specifications using MATLAB.
A8432.4. Demonstrate the concepts of discrete time signals and systems using DSP processors.
A8432.5. Design digital filters for the given specifications using DSP processors.

3. List of Experiments

The programs shall be implemented using MATLAB/ LAB view/ C Programming/OCTAVE or Equivalent/ Using TI/Analog Devices/Motorola/ Equivalent DSP processors

1. Generation of basic sequences.
2. Verification of Symmetry and energy/power of a discrete time signal.
3. Verification of linearity and time invariance properties of a given discrete time system.
4. Verification of stability of an LTI system.

5. Find the response of an LTI system.
6. Find the frequency response of a given system given DT system.
7. Find DFT/IDFT of given discrete time signal.
8. Find Linear and Circular Convolution using DFT.
9. Implementation of FFT of given sequence.
10. Determination of Power Spectrum of a given Signal(s).
11. Design of Butterworth IIR filters for a given sequence and verify the frequency response of the filter.
12. Design of Chebyshev IIR filters for a given sequence and verify the frequency response of the filter.
13. Design of FIR filter using windowing technique and verify the frequency response of the filter.
14. Generation of DTMF Signals.
15. Implementation of Decimation Process.
16. Implementation of Interpolation Process.
17. Implementation of I/D Sampling Rate Converters.

4. Laboratory Equipment/Software/Tools Required

1. Computers
2. MATLAB Software
3. CC Studio
4. TI/Analog Devices/Motorola/ Equivalent DSP processors.

5. Books and Materials

Text Books:

1. John G. Proakis, Dimitris G. Manolakis (2007), Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education / PHI, India.
2. Avtar Singh and S. Srinivasan (2006), Digital Signal Processing, Thomson Publication, India.

Reference Books:

1. M. H. Hayes (2007), Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.
2. Robert J. Schilling, Sandra L. Harris (2007), Fundamentals of Digital Signal Processing using Matlab, Thomson Publications, India.
3. Dimitris G. Manolakis, Vinay Ingle (2011), Applied Digital Signal Processing, Cambridge University Press, Newyork.

Course Structure

A8012 - Advanced English Communication Skills Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This Lab focuses on grooming the students professionally and empowering them through language development. This course facilitates them to hone their vocabulary and listening skills enabling them to prepare for competitive examinations. This course also polishes the students' presentation skills in different professional contexts besides developing proficiency in reading and writing. Further, they would be outfitted to communicate their ideas relevantly in group discussions and develop proficiency in preparing for interviews, thus making students ready for industry.

Course Pre/co-requisites

A8010 - English for Skill Enhancement
A8011 - English Language and Communication Skills Laboratory

2. Course Outcomes (COs)

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

A8012.1. Improve comprehensive skills in listening and reading.
A8012.2. Develop effective technical writing skills and e- correspondence.
A8012.3. Build communication skills in different socio-cultural and professional contexts.
A8012.4. Organize the dynamics of group discussion for effective participation.
A8012.5. Analyze strategies to succeed in interviews.

3. Course Syllabus

Theory

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills Laboratory **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub-skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading — Reading Comprehension – Exercises for Practice.

Activities on Writing Skills: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé – Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette – Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.

Activities on Presentation Skills: Starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation – Dealing with Glossophobia or Stage Fear – Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.

Activities on Group Discussion (GD): Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion- Myths of GD - Intervention, Summarizing - Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas – Do's and Don'ts - GD Strategies – Exercises for Practice.

Interview Skills: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

4. Laboratory Equipment/Software/Tools Required

1. Audio Visual Equipment (Public Address System, LCD Projector and Camcorder).
2. One PC with latest configuration for the teacher.
3. Delta's key to the Next Generation TOEFL, Test: Advanced Skill Practice.
4. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).
5. Oxford Advanced Learner's Dictionary, 10th Edition.
6. Cambridge Advanced Learner's Dictionary.
7. Lingua TOEFL CBT Insider, by Dreamtech.

5. Books and Materials

Text Books:

1. M. Ashraf Rizvi, Effective Technical Communication, 2nd Edition, McGraw Hill Education, 2018.
2. Suresh Kumar E, Engineering English, 1st Edition, Orient BlackSwan Pvt. Ltd, 2015.
3. Bailey, Stephen, Academic Writing: A Handbook for International Students (5th Edition), Routledge, 2018.
4. Koneru, Aruna, Professional Communication, McGraw Hill Education (India) Pvt. Ltd, 2016.

Reference Books/Additional Resources:

1. Meenakshi Raman & Sangeeta Sharma, Technical Communication, 3rd Edition, Oxford University Press, 2015.
2. Paul V. Anderson, Technical Communication, 8th Edition, Cengage Learning pvt. Ltd., New Delhi. 2013.
3. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart, English Vocabulary in Use Series. Cambridge University Press, 2017.
4. Sen, Leela, Communication Skills, PHI Learning Pvt Ltd., New Delhi, 2009.

5. Elbow, Peter, Writing with Power. Oxford University Press,1998.
6. Goleman, Daniel, Emotional Intelligence: Why it can matter more than IQ. Bloomsbury Publishing,2013.

Course Structure

A8035 - Research Methodology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	0	-	100	100

1. Course Description

Course Overview

Research is an art of scientific investigation. Research is an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison, and experiment. This course will help students to understand the research process, tools, and importance of ethics. Also, this course helps students to write technical reports.

Course Pre/Co-requisites

This course has no core requisites/pre-requisites

2. Course Outcomes (COs)

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

A8035.1. Identify an appropriate research problem in their suitable domain.
A8035.2. Explain the concepts and procedures of sampling, data collection, analysis, and reporting.
A8035.3. Analyze the complex issues inherent in selecting a research problem, research design, and implementing a research project.
A8035.4. Construct a well-structured research paper and scientific presentations.
A8035.5. Express the importance of research ethics in the scientific community.

3. Course Syllabus

Research Methodology: Introduction, meaning, objectives, motivation, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research. **Defining a Research Problem:** Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs, basic principles of experimental designs.

Measurement and Scaling: Measurement in research, measurement scales, sources of error in measurement, techniques of developing measurement tools, scale classification bases, scaling techniques.

Data Collection: Collection of primary data, observation method, interview method, collection of secondary data, selection of appropriate method for data collection, case study

method.

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports. **Research Tools and Techniques:** Methods to search required information effectively, reference management software like Zotero, Mendeley and EndNote, LaTeX (writing paper, thesis, report, bibliography), BEAMER for presentation, software for detection of plagiarism. ethical issues related to publishing, plagiarism and self-plagiarism.

4. Books and Materials

Text Books:

1. C.R. Kothari, Gaurav Garg "Research Methodology: Methods and Techniques" 4th Edition, New Age International, 2018
2. Ranjit Kumar "Research Methodology a step-by step guide for beginners", 3rd Edition, SAGE Publications Ltd, 2011.

Reference Books:

1. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing, 2005
2. Fink A "Conducting Research Literature Reviews: From the Internet to Paper" Stage Publications, 2009

IV YEAR I SEMESTER

Course Structure

A8435 – IoT Architectures and Protocols

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamentals of networking protocols and architecture used in Internet of Things (IoT). In particular, the course will focus on protocols and stack for low power wireless networking in both short-range and long- range settings. It covers in-depth discussion of protocols and algorithms at various layers of the network stack including medium access control, applications.

Course Pre/co-requisites

A8425- Microcontrollers

2. Course Outcomes (COs)

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

A8435.1. Analyze the impact and challenges posed by IoT networks leading to new Architectural model.
A8435.2. Understand the concepts of IoT Architecture Reference model used in real world Applications.
A8435.3. Determine the communication protocols to use in a particular IoT systems .
A8435.4. Apply IP based protocols and Authentication Protocols for IoT.
A8435.5. Analyze real-world problems and design suitable IoT-based solutions.

3. Course Syllabus

IoT Introduction: Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, Enabling Technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

IoT Reference Architecture: Introduction, Functional View, Information View, Deployment and Operational View. Real-World Design Constraints.

IoT Data Link Layer: PHY/MAC Layer (3GPP MTC, IEEE 802.11), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7. **Network Layer Protocols:**

Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP. Authentication Protocols: IEEE 802.15.4

IoT Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

Service layer protocols and Security: Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 6LoWPAN, RPL, Application Layer.

4. Books and Materials

Text Books:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy- Introduction to IoT, Cambridge University Press, 2021.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1st Edition, Academic Press, 2014.
3. Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. 1^{st} edition, John Wiley & Sons Lts, 2018.

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer, 2011.
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016.

Course Structure

A8436 – Mobile Communications and Networks

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is intended to stress the fundamentals of mobile communication engineering that are important to any mobile communication system. It introduces cellular mobile radio systems, performance criteria, design, operations, and various generations of cellular systems. It covers various types of interferences in mobile radio environment. This course describes cell coverage for signal and traffic, signal reflections in various terrains, various cell sites and mobile antennas and their analysis. This course explains different frequency management and channel assignment techniques and different handoff techniques and cell splitting and the architecture of cellular communication system.

Course Pre/co-requisites

A8422 – Digital Communications

A8423 – Antennas and wave Propagation

2. Course Outcomes (COs)

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

A8436.1. Inspect the cell splitting and sectorization techniques to increase the system capacity.

A8436.2. Analyze the frequency reuse pattern techniques for reducing the interference in a cellular communication system.

A8436.3. Analyze mobile radio propagation models and antennas for cell site and mobile unit.

A8436.4. Distinguish the channel assignment strategies and handoffs to achieve efficient spectrum utilization.

A8436.5. Analyze the architectures of modern cellular communication systems and their components to understand system operation and integration.

3. Course Syllabus

Cellular Mobile Radio Systems: Introduction to Cellular Mobile System, Why Cellular Mobile Telephone Systems, Trunking Efficiency, A Basic Cellular System, Performance Criteria, Uniqueness of Mobile Radio Environment, Operation of Cellular System. **Elements**

of Cellular Radio System Design: Concept of Frequency Channels, Co-Channel Interference Reduction Factor, Desired C/I From a Normal Case in a Omni-directional Antenna System, Handoff Mechanism, Cell Splitting.

Interference: Co-Channel Interference, Exploring Co-Channel Interference areas in a system, Design of an Omni Directional Antenna System in the worst case, Design of a Directional Antenna System, Lowering the Antenna height, Umbrella Pattern Effect, Use of Parasitic Elements, Power Control, Diversity Receiver. **Non Co-Channel Interference:** Adjacent-channel interference, near-end-far-end interference, effect on near-end mobile units, cross talk, effects of cell-site components, Interference between systems.

Cell Coverage for Signal and Traffic: General Introduction, Obtaining the Mobile Point-to Point Model (Lee Model): A Standard Condition, Obtain Area-to-Area Prediction Curves for Human-Made Structures, The Phase Difference between a Direct Path and a Ground-Reflected Path, Propagation over Water or Flat Open Area, Foliage Loss. **Cell Site and Mobile Antennas:** Antennas at Cell Site, Omni-directional Antennas, Directional Antennas for Interference Reduction, Unique Situations of Cell-Site Antennas, Mobile Antennas.

Frequency Management and Channel Assignment: Frequency Management, Frequency – Spectrum Utilization, Fixed Channel Assignment: Adjacent Channel Assignment, Channel Sharing and Borrowing, Sectorization, Underlay-Overlay arrangement, Non fixed Channel Assignment Algorithms. **Handoff:** Value of Implementing Handoffs, why handoffs, Types of Handoff, Forced Handoffs, Power-Difference Handoffs, Mobile Assisted Handoff (MAHO) and Soft Handoff, Cell-Site Handoff, Intersystem Handoff.

Digital Cellular Networks: GSM - GSM architecture, GSM Channels and channel modes, Multiple-access scheme, Radio resource management, Mobility management, Communication management, Network management. North American TDMA- History, NA-TDMA architecture. CDMA.

4. Books and Materials

Text Books:

1. William C. Y. Lee (2006), Mobile Cellular Telecommunications, 2nd Edition, Tata McgrawHill, India.
2. T.L.Singal (2010), Wireless Communication, Springer International, McGraw Hill, New Delhi. India.

Reference Books:

1. Gottapu Sasibhushana Rao (2012), Mobile Cellular Communications, Pearson education, India.
2. Theodore S. Rappaport (2002), Wireless Communications, 2nd edition, Pearson education, India.

Course Structure

A8437 – IoT Architectures and Protocols laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

The objective of this course is to give students hands-on experience using different Processors and Controllers and to interface sensors and actuators applications by collecting the data and logging the data through Cloud.

Course Pre/co-requisites

A8425 – Microcontrollers

2. Course Outcomes (COs)

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

A8437.1. Interface sensors with NodeMCU ESP 8266 and Raspberry pi to communicate with cloud.
A8437.2. Utilize the modern tools for programming processor and controller.
A8437.3. Identify the analog and digital sensors to interface with IoT devices.
A8437.4. Demonstrate the concept of communication protocols through sensor interfacing.
A8437.5. Analyze system requirements to implement IoT applications using ARIES boards for real-time problem-solving

3. List of Experiments

Cycle I: (NODE MCU and Raspberry Pi)

1. Harmful Gas detection using MQ02/05 and NodeMCU ESP 8266.
2. Distance measurement using ultrasonic sensor and NodeMCU ESP 8266.
3. Light intensity measurement using LDR and NodeMCU ESP 8266.
4. Obstacle detection using IR sensor and NodeMCU ESP 8266.
5. Water quality measurement using Raspberry Pi.
6. Blink LED using Raspberry Pi.
7. Interface DHT11 sensor with Raspberry Pi and compose a program to print Temperature and Humidity reading on screen.
8. Implement Raspberry Pi program for Distance Measurement Using Ultrasonic Sensor and displaying on LCD.

Cycle II: (ARIES Arduino compatible Boards)

1. Generate siren for 5sec in every 1 minute.
2. Beating heart animation using Dot matrix display.
3. Compose a program to print temperature and moisture.
4. Interface IR Sensor using Aries board.
5. Bluetooth module interfacing using Aries board.
6. Touch Sensor using Aries board.
7. Write an Arduino program to demonstrate UART communication protocol.
8. Write an Arduino program to demonstrate I2C communication protocol.

4. Laboratory Equipment/Software/Tools Required

1. A Computer System with Ubuntu Operating System.
2. Python software
3. Arduino IDE
4. Raspberry PI 4
5. Node MCU (ESP8266)
6. VEGA ARIES development Board.
7. DHT11 (Digital Humidity and Temperature) sensor
8. LDR (Light Dependent Resistors) Sensor
9. Infrared sensor
10. Ultrasonic Sensor
11. Touch sensor.
12. Bluetooth module
13. Moisture sensor
14. pH sensor

5. Books and Materials

Text Books:

1. Arshdeep Bahga and Vijay Madisetti., Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1^{st} edition, John Wiley & Sons, 2019.

Reference Books:

1. Pethuru Raj and Anupama C. Raman., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press,2017.
2. Matt Richardson & Shawn Wallace., Getting Started with Raspberry Pi, O'Reilly Publications, 2014.

Course Structure

A8438 – Advanced Communications Laboratory

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
0	0	2	0	0	30	1	40	60	100

1. Course Description

Course Overview

This course is intended to stress the fundamentals of mobile communication engineering that are important to any mobile communication system. This course deals with cellular frequency reuse, sectoring and handoff mechanism. This course gives insights of Transmitted (I & Q) /Received (I & Q) Signals Constellations and analysis of various propagation path loss models. This course also gives an analysis of DSSS technique for CDMA and design and measurement of performance parameters of various antennas. .

Course Pre/co-requisites

A8422 – Digital Communications

A8436 – Mobile Communications and Networks

2. Course Outcomes (COs)

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

A8438.1. Inspect the Transmitted and Received signals to increase the system capacity.
A8438.2. Analyze the frequency reuse pattern techniques, sectoring and handoff mechanism for reducing the interference in a cellular communication system.
A8438.3. Analyze mobile various propagation path loss models.
A8438.4. Analyze DSSS technique for CDMA and observe effect of variation of types of PN codes to achieve efficient spectrum utilization and analyze AT commands, buzzer and vibrator of 4G LTE Smart Phone.
A8438.5. Calculate performance parameters of various types of antennas .

3. List of Experiments

1. Inspect the Transmitted (I & Q) /Received (I & Q) Signals Constellations.
2. Examine the concept of cellular frequency reuse, sectoring and handoff mechanism.
3. Analyze Line-of-Sight (LOS), Two-Ray propagation path loss models.
4. Analyze the relation between bit rate, symbol rate and chip rate of DSSS technique for CDMA.
5. Examine the effects of variation of different types of PN codes in DSSS technique.
6. Obtain the Bit Error Rate of DSSS CDMA.

7. Analyze the AT commands of 4G LTE Smart Phone
8. Analyze the buzzer and vibrator of 4G LTE Smart Phone
9. Study the features of Network and spectrum analyzer
10. Design, simulate and measurement of performance parameters of Dipole Antenna.
11. Design, simulate and measurement of performance parameters of Horn Antenna.
12. Design, simulate and measurement of performance parameters of Microstrip Patch Antenna.

4. Laboratory Equipment/Software/Tools Required

1. MATLAB
2. 4G Communication Kit
3. CDMA Trainer kit
4. Network Analyzer
5. HFSS EM Simulator

5. Books and Materials

Text Books:

1. William C. Y. Lee (2006), Mobile Cellular Telecommunications, 2nd Edition, Tata McgrawHill, India.
2. Kraus, John D., Ronald J. Marhefka, and Ahmad Khan. Antennas and Wave Propagation. New Delhi: Tata McGraw Hill Education, 2011.

Reference Books:

1. T.L.Singal (2010), Wireless Communication, Springer International, McGraw Hill, New Delhi. India.
2. Gottapu Sasibhushana Rao (2012), Mobile Cellular Communications, Pearson education, India.
3. Theodore S. Rappaport (2002), Wireless Communications, 2nd edition, Pearson education, India.
4. Erik Dahlman, Stefan Parkvall, and Johan Skold (2011), 4G: LTE/LTE-Advanced for Mobile Broadband, Elsevier.

Professional Electives

Course Structure

A8451 - SystemVerilog for Verification

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course gives you a thorough introduction to the key System-Verilog improvements to the Verilog hardware description language (HDL), examines the advantages of the new capabilities, and shows how employing System-Verilog structures may make design and verification more effective and efficient. In this course, the Verification module investigates verification improvements including object-oriented design, assertions, and randomization, whereas the Design module analyses improvements for RTL design and synthesis.

Course Pre/co-requisites

A8401 - Digital Logic Design

2. Course Outcomes (COs)

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

A8451.1 Identify the concepts of verification methodologies and data types.
A8451.2 Apply the concepts of procedural statements, routines and assertions to construct digital circuits.
A8451.3 Analyze the concepts of functional coverage for given specifications.
A8451.4 Make use of the concepts of OOP terminology in system verilog HDL.
A8451.5 Examine the design functionality by applying randomization in system verilog HDL.

3. Course Syllabus

SystemVerilog Overview: The Verification Process, the Verification Methodology Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance, UVM Test Bench Architecture.

Data Types: Built-In Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, choosing a Storage Type, Creating New Types with type def, Creating User-Defined Structures, Type conversion, Enumerated Types, Constants, Strings. **Procedural Statements and Routines:** Procedural Statements, Tasks, Functions, and Void Functions, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

Connecting The Testbench and Design: Separating the Test bench and Design, the Interface Construct, Stimulus Timing, Interface Driving and Sampling, Connecting It All

Together, top-Level Scope, Program – Module Interactions, System Verilog Assertions, The Four-Port ATM Router, the ref Port Direction, The End of Simulation. **Functional Coverage:** Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, Anatomy of a Cover Group, triggering a Cover Group, Data Sampling, Cross Coverage, Generic Cover Groups, Coverage Options, Analyzing Coverage Data, Measuring Coverage Statistics During Simulation.

Basic OOP: Introduction, Where to Define a Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Static Variables vs. Global Variables, Class Methods, Defining Methods Outside of the Class, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Local, Straying Off Course, Building a Testbench.

Randomization: introduction, what to randomize, randomization in system Verilog, constraint details solution probabilities, controlling multiple constraint blocks, valid constraints, in-line constraints, the pre-randomize and post randomize functions, random number functions, constraints tips and techniques, common randomization problems, Iterative and Array Constraints, Atomic Stimulus Generation vs. Scenario Generation, Random Control, Random Number Generators, Random Device Configuration.
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4. Books and Materials

Text Books:

1. Chris Spear, System Verilog for Verification, Second Edition, Springer.
2. Universal Verification Methodology (UVM) 1.2 User's Guide, 2015.
3. Janik Bergeron, Writing Test Benches:Functional Verification of HDL models, 2nd edition.

Reference Books:

1. Stuart Sutherland Simon Davidmann Peter Flak, SystemVerilog For Design Second Edition A Guide to Using SystemVerilog for Hardware Design and Modeling

Course Structure

A8452 - Real Time Operating Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course offers a comprehensive understanding of the QNX Real-Time Operating System (RTOS) and its applications in embedded systems. It covers the microkernel-based architecture, process and thread management, synchronization techniques, and inter-process communication (IPC) methods. Students will gain hands-on experience in application development using the QNX Momentics IDE, learn hardware access methods, interrupt handling, and real-time timing mechanisms. The course also includes building and configuring QNX boot images and implementing resource managers. By the end, learners will be equipped with the skills to develop robust, real-time embedded solutions aligned with POSIX standards and industry best practices.

Course Pre/co-requisites

A8416 – Computer Organization and Microprocessors
A8425– Microcontrollers

2. Course Outcomes (COs)

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

A8452.1 Differentiate the architectural components of QNX RTOS and analyze its microkernel-based design with POSIX compliance.
A8452.2 Develop, test, and debug real-time applications using QNX Momentics IDE.
A8452.3 Implement process and thread management using synchronization techniques like mutexes and condition variables.
A8452.4 Design and apply inter-process communication (IPC) mechanisms such as message passing and shared memory.
A8452.5 Configure and generate QNX boot/OS images tailored to specific embedded hardware platforms.

3. Course Syllabus

Introduction to QNX OS Architecture: Overview of QNX OS architecture, Microkernel, process manager, and standards, Protected address spaces, process/thread model, and scheduling, Introduction to inter-process communication (IPC) and synchronization, Resource managers and shared objects.

Processes, Threads, and Synchronization: Process management: creation, termination, and memory protection, Thread management: creation, termination, and synchronization, Synchronization techniques: mutexes, semaphores, and condition variables, process/thread creation and synchronization.

Inter-Process Communication (IPC): Overview of IPC methods in QNX: message passing, pulses, and shared memory, Comparing IPC methods, advantages and disadvantages, implementation of IPC in QNX, message passing and shared memory.

Hardware Programming and Timing: Hardware access methods: I/O-mapped and memory-mapped I/O, Interrupt handling and DMA-safe memory allocation, Timing architecture: periodic timing, one-shot timing, and timeouts, interrupt handling and timing mechanisms.

Building and Configuring QNX Boot/OS Images: Overview of QNX boot/OS image structure, Components of a boot image: startup code, kernel, drivers, and scripts, Building and loading boot images onto target hardware, Introduction to resource managers and their implementation.

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4. Books and Materials

Text Books:

1. QNX Software Systems, QNX® Neutrino® RTOS System Architecture, ver. 6.4.1, QNX Software Systems GmbH & Co. KG., Kanata, ON, Canada: QNX Software Systems International Corp., 2009.
2. QNX Neutrino RTOS User's Guide, QNX Software Systems.

Reference Books:

1. M. Barr, Programming for Embedded Systems, Sebastopol, CA, USA: O'Reilly Media.
2. B. Amos, Hands-on RTOS with Microcontrollers, Birmingham, U.K.: Packt Publishing, 2020
3. A. Silberschatz, P. B. Galvin, and G. Gagne, Operating System Concepts, 9th ed., Hoboken, NJ, USA: Wiley, 2018

Course Structure

A8453 - Digital Image Processing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Digital image processing deals with processing of images which are digital in nature. The primary goal of this course is to lay a solid foundation for students to study basic image processing functionalities in detail so that they can design real life applications based on their learning of the key concepts. Visual information plays an important role in almost all areas of our life. Today, much of this information is represented and processed digitally. Digital image processing is ubiquitous, with applications ranging from television to monography, from photography to printing, from robotics to remote sensing.

Course Pre/co-requisites

A8408 – Signals and Systems

2. Course Outcomes (COs)

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

A8453.1 Interpret the fundamentals of digital image formation, representation and various operations on digital images.
A8453.2 Apply the concepts of enhancement techniques in spatial domain to enhance the quality of an image.
A8453.3 Analyze images in the frequency domain using various transforms.
A8453.4 Apply suitable morphological and segmentation algorithms to extract features of interest in an image.
A8453.5 Outline the various feature extraction techniques for image analysis and recognition.

3. Course Syllabus

Digital Image Fundamentals: Fundamentals of Image Processing, Applications of Image Processing, Components of an Image Processing System, Image File Formats, Relationships between Pixels, Mathematical Tools Used in Digital Image Processing- Arithmetic Operations, Set and Logical Operation, Spatial Operations, Vector and Matrix Operations. **Image Transforms:** 2D DFT and IDFT, Properties, Hadamard Transform, Discrete Cosine Transform, Haar Transform.

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering. **Image Enhancement (Frequency Domain):** Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in

Frequency Domain.

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation. **Morphological Image Processing:** Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation.

Image Compression: Redundancies and their Removal Methods, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding. **Image Restoration:** Degradation Model, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration.

Concept of Image Feature Extraction and classification: Concept of feature extraction, Gray level co-occurrence matrix, Gabor features, Local binary pattern, LOG and DOG operators, introduction to feature classification.

4. Books and Materials

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 4th Edition, Pearson Education, New Delhi, India

Reference Books:

1. Anil K Jain, Fundamentals of digital image processing by, Low Price Edition, Pearson Education, 2005.
2. Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, Digital Image Processing using MATLAB, 2nd Edition, TMH, New Delhi, 2010

Course Structure

A8454 - Computer Communication Networks

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides the concepts and fundamentals of data communication and computer networks. Topics include layered network architecture, error detection and correction mechanisms in Data Link layer, Multiple access protocols, IP addressing, Routing in Network layer, different routing protocols, communication reliability, web and email protocols. Course will cover the Architecture of Wired and Wireless Local Area Networks and switching techniques in Network.

Course Pre/co-requisites

A8417 – Analog Communications

2. Course Outcomes (COs)

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

A8454.1 Apply the fundamentals of data communication to describe the OSI model, TCP/IP protocol suite.

A8454.2 Design and analyse various error detection techniques for developing better communication networks.

A8454.3 Analyse the functionalities of the network layer and addressing mechanism to design efficient internetworking solutions..

A8454.4 Analyse the significance of various Flow control and Congestion control Mechanisms to reduce errorss.

A8454.5 Examine the application-layer architecture and Analyse protocols to implement network-based applications and services.

3. Course Syllabus

Introduction: Data Communication, Layers in OSI model, TCP/IP Protocol Suite, Addressing, Transmission Media: Guided media, Unguided media.

Data link control: Framing, Flow and Error control, Protocols, Noiseless channels and Noisy channels, HDLC, point to point protocol, Multiple Accesses: Random access, Controlled access, Channelization Protocols.

Network Layer: Internetworking, IPv4, Datagram, Fragmentation, IPv6, Packet Format, Extension Headers, Transition from Ipv4 to Ipv6, dual stack tunneling, header translation. Transport layer: Process to process Delivery, User Datagram Protocol.

Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control.

Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

4. Books and Materials

Text Books:

1. Kurose James F, Keith W- Computer Networking A Top-Down Approach,6th Edition, Pearson.
2. Behrouz A. Forouzan - Data Communications and Networking, 4th Edition, McGraw-Hill Education
3. Data Communication and Networking, B Forouzan, 4th Ed, TMH 2006

Reference Books:

1. Bhusan Trivedi - Data communication and Networks, Oxford university press, 2016
2. Andrew S Tanenbaum - Computer Networks,4th Edition, Pearson Education
3. W. A. Shay - Understanding Communications and Networks, 3rd Edition, Cengage Learning.
4. Introduction to Data communication and Networking, Wayne Tomasi: Pearson education 2011.

Course Structure

A8455 - FPGA Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Field Programmable Gate Arrays (FPGAs) combines together the flexibility of microprocessor and high performance of Application Specific Integrated Circuit (ASIC) to implement digital systems that were traditionally constructed into custom silicon. FPGAs can be used to implement any logic function that an ASIC can perform. The ease of programming and debugging with FPGAs decreases the overall non-recurring-engineering (NRE) costs and time-to-market of the developed products when compared to ASICs. Any flaws in the final FPGA-based product can be easily corrected by simply reprogramming the FPGA, unlike other technologies that embed hardware directly into silicon. This course deals with the basics of digital system design using ROM, PLDs, CPLDs, FPGA fabrics and introduces essential FPGA concepts and programming. This course is appropriate for all the students interested in applications of digital systems and FPGA programming.

Course Pre/co-requisites

A8401 – Digital Logic Design

2. Course Outcomes (COs)

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

A8455.1 Apply the concept of programming logic devices to model various applications.

A8455.2 Analyze the structural and functional elements of FPGA architecture to evaluate their interactions and implications in digital system implementation.

A8455.3 Analyze the design principles and structural variations of SRAM-based FPGA architectures to interpret their functional characteristics and application-specific advantages.

A8455.4 Analyze antifuse FPGA architectures by exploring their structural design, programming methodology, and performance characteristics to evaluate their effectiveness across diverse application domains.

A8455.5 Make use of the knowledge of FPGAs in designing and implementing digital ICs.

3. Course Syllabus

Introduction to PLDs and FPGAs: Introduction, Simple PLDs, CPLDs, FPGAs, Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs.

SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture - the Xilinx XC2000, XC3000 and XC4000 Architectures.

Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture - the Actel ACT1, ACT2 and ACT3 Architectures.

Designing with Field Programmable Gate Arrays-I: Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Carry Chains in FPGAs, Cascade Chains in FPGAs.

Designing with Field Programmable Gate Arrays-II: Examples of Logic Blocks in Commercial FPGAs, Dedicated Memory in FPGAs, Dedicated Multipliers in FPGAs, Cost of Programmability, FPGAs and One-Hot State Assignment, FPGA Capacity: Maximum Gates versus Usable Gates, Design Translation (Synthesis), Mapping, Placement, and Routing.

4. Books and Materials

Text Books:

1. Stephen M. Trimberger, "Field Programmable Gate Array Technology", Springer International 1st Edition.
2. Charles H. Roth Jr, Lizy Kurian John, "Digital Systems Design using VHDL", Cengage Learning, 3rd Edition.

Reference Books:

1. Ian Grout, "Digital Systems Design with FPGAs and CPLDs", Elsevier, Newnes.
2. Wayne Wolf, "FPGA based System Design", Prentice Hall Modern Semiconductor Design Series.
3. John V. Oldfield, Richard C. Dorf, "Field Programmable Gate Arrays", Wiley India.
4. Pak K. Chan, Samiha Mourad, "Digital Design Using Field Programmable Gate Arrays", Pearson Low Price Edition

Course Structure

A8456 - Advanced Core Architectures

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to provide learners with a fundamental knowledge of advanced computer hardware and computing techniques with an emphasis on system design and its performance. Majorly, concentrates on the principles underlying systems organization, issues in computer system design and contrasting implementations of modern systems. The course is central to the aims of the Embedded Systems core domain in context to modem computer system engineering, memory systems, instruction & thread level parallelism, SIMD & MIMD architectures.

Course Pre/co-requisites

A8416 - Computer Organization and Operating Systems

2. Course Outcomes (COs)

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

A8456.1 Apply pipelining and vector processing techniques to improve performance of computers.

A8456.2 Make use of registers, complementor, parallel adders and sequence counters to design arithmetic and logical unit for computers.

A8456.3 Examine the features of shared memory and distributed memory computer organizations for multiprocessor and multi computer systems.

A8456.4 Classify the parallel computer models based on system attributes and performance.

A8456.5 Illustrate the multithreaded and super scalar models of advanced core architecture computers.

3. Course Syllabus

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

Computer Arithmetic: Addition and Subtraction, Hardware Implementation, Multi- plication Algorithms and Hardware Implementation, Division Algorithms and Hardware Implementation, Floating Point Arithmetic Operations.

Parallel Computer Models: Evolution of Computer Architecture, System Attributes to Performance, Shared Memory Multiprocessors, Distributed Memory Multicomputer, Vector Super Computers, SIMD Super Computers.

Multicore Architecture and Vector: Simultaneous multithreaded (SMT) architec- tures, SMT Architecture Alternatives, SMT architecture: OS impact and adaptive archi- tectures, OS impact and adaptive architectures, Multi-core Architectures, Single Instruction Multiple Data (SIMD) MMX, SSE.

Pipelining and Super Scalars: Linear Pipeline Processors: Asynchronous and Synchronous models, Clocking and Timing Control, Speedup, Efficiency and Throughput, Pipeline Schedule Optimization, Instruction Pipeline Design: Instruction Execution Phases, Mechanisms for Instruction Pipelining, Dynamic Instruction Scheduling, Branch Handling Techniques.

4. Books and Materials

Text Books:

1. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.
2. Sergej Fatikow and Ulrich Rembold, " Microsystem Technology and Microbotics", First edition, Springer –Verlag NEwyork, Inc, 1997.
3. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010

Reference Books:

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997.
4. Manfred Kohl, "Shape Memory Actuators", first edition, Springer

Course Structure

A8457 - Machine Learning for Visual Analysis

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course will enable students to study cutting-edge technologies in the field of machine learning for visual analysis, and will provide them with the background and skills they need to pursue careers in research or industry.Course content covers Fundamental methods and techniques in computer vision, machine learning and image processing. This course also deals with techniques for the application of machine learning methods to analyse visual data and techniques for systems and applications.

Course Pre/co-requisites

A8453 - Digital Image Processing
A8461 - Machine Learning for Signal Processing

2. Course Outcomes (COs)

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

A8457.1. Interpret the image formation process for reconstruction.
A8457.2. Apply pre-processing techniques on digital images for better classification.
A8457.3. Apply feature descriptor techniques on images to extract application dependent features.
A8457.4. Analyze the machine learning models to solve real-time pattern classification problems.
A8457.5. Analyze the impact of machine learning models in face and gesture recognition.

3. Course Syllabus

Introduction to Machine Vision: Introduction, Goals of Computer Vision, concept of pattern recognition, Image Formation process, Radiometry, 2D Geometric Transformations, Single camera setup of image formation, Image Reconstruction from a Series of Projections, Radon transformation, Fourier transform method of image reconstruction.

Image Processing Concepts: Components of an Image Processing System, digital image representation, Spatial or neighbourhood operations,Spatial domain filtering, Wiener filter for image restoration,K-L transform, Discrete wavelet transform, Binary morphological operations, Image Segmentation.

Visual Descriptors and Features: Texture Descriptors, Color Features, Edge Detection, Object Boundary and Shape Representations, Interest or Corner Point Detectors, HOG,

SIFT, SURF, Visual Matching: Bag-of-words, VLAD, RANSAC, Hough transform, Pyramid Matching.

Pattern Classification: Introduction to Pattern Recognition, block diagram, Steps in pattern recognition, Types of classifier,Training and testing, accuracy measurement parameters, confusion matrix, Linear Regression, Linear discriminant functions, Minimum distance classifier, Euclidean and Mahalanobis distances, Gaussian Classifier,k-NN Classifier, Clustering, Dimension Reduction, PCA, LDA, ANNs for Pattern Classification.

Applications of Visual Analysis: Medical Image Segmentation, Challenges, Overview of video surveillance system, Object tracking, Face Recognition system, challenges, Vision based hand gesture recognition system, Image Fusion.

4. Books and Materials

Text Books:

1. M. K. Bhuyan, Computer Vision and Image Processing Fundamentals and Applications, CRC Press, Taylor & Francis Group, 2019.

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Fourth Edition, PHI, 2018.
2. Andreas C. Muller and Sarah Guido, Introduction to Machine Learning with python, O'reilly, 2017.

Course Structure

A8458 - Wireless Communications and Networks

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Wireless communications and networks have become ubiquitous technologies in the past couple of decades. The objective of this course is to introduce the fundamentals of the wireless Communications systems, the wireless network architectures, protocols, and applications. This course covers the basic principles of wireless communications and wireless network architectures. Topics of study include an overview of wireless communication systems, spread-spectrum modulation for wireless systems, Wireless Application Protocol, 4G and 5G technologies, multiple access techniques, and wireless networking standards (e.g., 2.5G, 3G, 4G, 5G, IEEE 802.11, 802.15 and IEEE 802.16).

Course Pre/co-requisites

A8417- Analog Communications
A8422- Digital Communications
A8423- Antennas and Wave Propagation

2. Course Outcomes (COs)

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

A8458.1 Apply the knowledge of various systems, techniques and technologies for effective wireless communication.
A8458.2 Analyze the different types of protocols, multiple access techniques and standards for the development of wireless networking.
A8458.3 Evaluate the importance of mobile radio Propagation, fading and path loss models.
A8458.4 Examine wireless communication systems of 4G and 5G technologies.
A8458.5 Apply the concept of network architecture, protocols, and capabilities for the development of various wireless networks.

3. Course Syllabus

Introduction to Wireless Communication Systems: Evolution of mobile radio communications, examples of wireless communication systems-paging systems, cordless telephone systems, cellular telephone systems, comparison of common wireless communication systems. Modern Wireless Communication Systems: Historical Trend of Wireless Communications, Evolution of LTE Technology to Beyond 4G,5G Roadmap,10 Pillars of 5G.

Multiple Access Techniques for Wireless Communication: Introduction, FDMA, TDMA, spread spectrum multiple access, FH-CDMA, DS-CDMA, SDMA, packet radio,

packet radio protocols, CSMA protocols, reservation protocols, capacity of cellular systems.

Radio Propagation and Propagation Path-Loss Models: Introduction, Free-Space Attenuation, Attenuation over Reflecting Surface, Effect of Earth's Curvature, Radio Wave Propagation, Characteristics of a Wireless Channel: Multipath Delay Spread, Coherence Bandwidth, and Coherence Time, Signal Fading Statistics: Rician Distribution, Rayleigh Distribution, Lognormal Distribution, Propagation Path-Loss Models: Okumura/Hata Model, Indoor Path-Loss Models, Fade Margin, Link Margin.

Wireless Communication Systems and Technologies: Introduction, Features and challenges, applications, 4G technologies: Multicarrier modulation, smart antenna techniques, OFDM – MIMO systems, Adaptive modulation and coding with time slot scheduler, BLAST system, SDR and cognitive radio. **Wireless Application Protocol:** Introduction, WAP Programming Model, WAP Architecture, WAP Advantages and Disadvantages, Applications of WAP.

Wireless Networks: Introduction to wireless networks, advantages and disadvantages of wireless local area networks, WLAN topologies, WLAN standard IEEE 802.11, IEEE 802.11 medium access control, comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, HIPERLAN2, WLL.

4. Books and Materials

Text Books:

1. Theodore S. Rappaport (2002), Wireless Communications - Principles Practice, 2nd edition, Prentice Hall of India, New Delhi.
2. Vijay K Garg (2010), Wireless Communication and Networking, Morgan Kaufmann Publishers.
3. Jonathan Rodriguez (2015), Fundamentals of 5G Mobile Networks, John Wiley & Sons, Ltd

Reference Books:

1. William Stallings (2009), Wireless Communications and Networks, 2nd edition, Pearson Education, India.
2. Andrea Goldsmith (2005), Wireless Communications, Cambridge University Press.
3. Andreas F. Molisch (2006), Wireless Communications, Wiley – India, New Delhi.
4. Erik Dahlman, Stefan Parkvall, and Johan Sköld (2011)4G: LTE/LTE-Advanced for Mobile Broadband, Elsevier.

Course Structure

A8459 - CMOS Analog IC Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides a comprehensive foundation in CMOS Analog Integrated Circuit Design, focusing on the analysis and design of key analog building blocks used in modern VLSI systems. It covers essential topics such as MOS device physics, single-stage and differential amplifiers, current mirrors, and operational amplifiers. Emphasis is placed on understanding the small-signal behavior, frequency response, and performance trade-offs in analog circuits. Students will gain skills in applying transistor-level models, analyzing analog circuit topologies, and designing biasing schemes, enabling them to develop robust analog IC solutions for real-world applications in consumer electronics, communications, and sensor interfaces.

Course Pre/co-requisites

A8403 – Electronic Devices and Circuits
A8407 – Electronic Circuit Analysis
A8415 – Analog Electronic Circuits

2. Course Outcomes (COs)

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

A8459.1 Apply MOS device characteristics and second-order effects to analog circuit analysis.
A8459.2 Design single-stage MOS amplifier configurations for specific gain and impedance requirements.
A8459.3 Analyze the performance of differential amplifiers under common-mode and differential-mode operation.
A8459.4 Apply current mirror topologies to design biasing circuits in CMOS analog design.
A8459.5 Compare operational amplifier topologies considering gain, bandwidth, and power trade-offs.

3. Course Syllabus

MOS Device Physics and Models: Introduction to analog design, MOS device physics – General Characteristics, MOS I/V Characteristics, Second-Order Effects, MOS Device Models.

Single Stage Amplifiers: Basic Concepts, Common-Source Stage with resistive-load and diode-connected load, Source Follower, Common-Gate Stage.

Differential Amplifiers: Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Mode with MOS Loads, Gilbert Cell.

Passive and Active Current Mirrors: Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors

Operational Amplifiers: General Considerations, One-Stage Op Amps, Two-Stage Op Amps, Gain Boosting, Comparison.

4. Books and Materials

Text Books:

1. Razavi, Behzad. Design of Analog CMOS Integrated Circuits. McGraw-Hill, 2000.

Reference Books:

1. David A. Johns, Ken Martin- Analog Integrated Circuit Design, Wiley Student Edn,2013.
2. Allen, Phillip E., and Douglas R. Holberg. CMOS Analog Circuit Design. 3rd ed., Oxford University Press, 2012.
3. Baker, Liand Boyce - CMOS: Circuit Design, Layout and Simulation, PHI.
4. Paul R. Gray, Paul J. Hurst, S. Lewis and R.G. Meyer -Analysis and Design of Analog Integrated Circuits, 5th edition, Wiley India, 2010
5. Sedra, Adel S., and Kenneth C. Smith. Microelectronic Circuits: Theory & Applications. Adapted by A. N. Chandorkar, 6th ed., Oxford University Press, 2013

Course Structure

A8460 - Embedded System Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Embedded systems course is intended to Design, Implementation and Testing of embedded applications. This course introduces the basic concepts like purpose and quality attributes of embedded systems. It covers the differences between the general-purpose computers and specific purpose computers and selection of memory according to the requirement for a system.This course presents ASICs, PLDs, COTS, Memory Interface, communication interface, embedded firmware design and development, RTC, RTOS, Task, task scheduling. It covers the task synchronization techniques, device drivers. It gives the knowledge how to select microprocessors, microcontrollers and real time operating system to develop various projects.

Course Pre/co-requisites

A8416 – Computer Organization and Microprocessors
A8425 - Microcontrollers

2. Course Outcomes (COs)

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

A8460.1 Utilize the classification of embedded systems based on performance, complexity, and era to assess their suitability for modern applications.
A8460.2 Examine the factors influencing the selection of memory, sensors, actuators, and their interfacing to design optimized embedded systems.
A8460.3 Implement various approaches to embedded firmware development, integrating hardware and software considerations effectively.
A8460.4 Analyze the role of real-time operating systems (RTOS) in embedded firmware design, focusing on task scheduling, multitasking, and multiprocessing.
A8460.5 Apply task synchronization techniques to evaluate address latency and performance challenges in embedded systems.

3. Course Syllabus

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing,

Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Embedded Firmware Design and Development: Reset Circuit, Brown-out Protec-tion Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

4. Books and Materials

Text Books:

1. Shibu K.V, Introduction to Embedded Systems, TATA Mc Graw Hill, 2009.

Reference Books:

1. Raj Kamal, Embedded Systems Architecture, Programming and Design, 3rd edition, TMH, 2017.
2. Frank Vahid, Tony Givargis, Embedded System Design, John Wiley, 2009.

Course Structure

A8461 - Machine Learning for Signal Processing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims at introducing the students to the fundamentals of machine learning techniques useful for various real world applications related to the signal processing. It will discuss various mathematical methods involved in ML, thereby enabling the students to design their own models and optimize them efficiently. The lectures will focus on mathematical principles, and there will be coding based assignments for implementation. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

Course Pre/co-requisites

1. A8002 – Ordinary Differential Equations and Vector Calculus
2. A8409 – Probability Theory and Stochastic Processes

2. Course Outcomes (COs)

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

A8461.1 Interpret the fundamentals of Machine Learning for classification of problem.
A8461.2 Apply the basics of mathematics to Machine Learning concepts.
A8461.3 Distinguish the types of machine learning algorithms.
A8461.4 Design machine learning algorithms for real time applications.
A8461.5 Implement machine learning models for face and gesture recognition.

3. Course Syllabus

Introduction to Machine Learning: Basics of Machine Learning, Applications of Machine Learning, Types of Machine Learning, comparison -supervised and unsupervised learning, reinforcement learning, applications, tools for machine learning, importance of database for machine learning..

Supervised Learning-Classification: Introduction, Examples of supervised learning, classification steps, k-nearest neighbors, Decision Trees, Over fitting in decision trees, random forest model.

Supervised Learning-Regression: Introduction to regression, importance of regression analysis, examples of regression, Simple Linear Regression, Multiple linear regressions, Assumptions in regression analysis, polynomial regression, and logistic regression, Logistic

Regression, classification.

Unsupervised Learning: Introduction, Unsupervised vs supervised learning, applications of unsupervised learning, clustering, types of clustering techniques,K-means clustering, Hierarchical clustering, density-based clustering, DBSCAN, Dimensionality Reduction, Principal Component Analysis (PCA).

ML in signal processing applications: Introduction to machine vision, image processing, steps involved in image processing, pixel relations, dilation and erosion, segmentation, clustering based segmentation, GLCM and LBP features descriptors, canny edge detection, ML for face recognition, gesture recognition, block diagram of speech recognition system.

4. Books and Materials

Text Books:

1. Saikat Dutt, Subramanian Chadramouli, Amit Kumar Das, Machine Learning (2021), Pearson, India.

Reference Books:

1. M. K. Bhuyan, Computer Vision and Image Processing Fundamentals and Applications, CRC Press, Taylor & Francis Group
2. Andreas C. Müller & Sarah Guido, Introduction to Machine Learning with python, O'reilly, 2017.

Course Structure

A8462 - Satellite and Radar Communications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamentals of satellite and radar communications and their real-time applications in the present and future scenario. The concepts of orbital systems and satellite launching mechanism deal with the transfer of information globally with the help of satellites. The radar range equation in its many forms is developed and applied to different situations. Radar transmitters, antennas, and receivers are covered. The fundamentals of radar target detection in presence of a noise background are discussed. The classification of pulse and continuous types of radars are addressed. MTI and pulsed Doppler processing performance are addressed.

Course Pre/co-requisites

A8422- Digital Communications
A8423- Antennas and Wave Propagation

2. Course Outcomes (COs)

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

A8462.1 Analyze the location of the satellite using orbital mechanics and launching procedures.
A8462.2 Categorize various multiple access techniques and evaluate link budgets for different frequency bands.
A8462.3 Apply the radar equation for prediction of range performance.
A8462.4 Analyze the features of radar receiver's components and their usage in aerospace guidance.
A8462.5 Demonstrate the fixed and moving targets using different types of tracking radars.

3. Course Syllabus

Origin of Satellite Communications: Historical Background, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. **Satellite Subsystems:** Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.

Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, uplink design, Design of satellite links for specified C/N, System design example. **Multiple Accesses:** Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure,

Examples. Code Division Multiple Access (CDMA).

Earth Station Technology: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

Introduction to Radar: The Nature of Radar, Maximum unambiguous range, Radar waveforms, Simple form of Radar equation, Radar block diagram & Operation, Radar frequencies and applications, and Related Problems. **Radar Equation:** Prediction of Range performance, Minimum detectable signal, Receiver Noise & SNR, Integration of Radar pulses, PRF & Range Ambiguities, System losses, and Related Problems. **CW and Frequency Modulated Radar:** Doppler Effect, CW Radar, Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, FM-CW Radar-Range and Doppler.

MTI and Pulse Doppler Radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter. Delay Line Cancellers, Filter Characteristics, Blind Speeds, Double Cancellation, MTI Radar Parameters, and Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler Radar. **Tracking Radar:** Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar - Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse.
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4. Books and Materials

Text Books:

1. Timothy Pratt (2003), Satellite Communications, 2nd edition, Wiley Publications, India.
2. Merill I. Skolnik (2007), Introduction to Radar Systems, 2nd edition, Tata McGraw-Hill, India

Reference Books:

1. M. Richharia (2003), Satellite Communications: Design Principles, 2nd edition, BS publications, India.
2. Dennis Roddy (2006), Satellite Communications, 2nd edition, Tata McGraw-Hill, India.
3. John. D. Kraus (2007), Electromagnetics, 6th edition, McGraw Hill, New Delhi.

Course Structure

A8463 - VLSI Physical Design Automation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides the concepts of design optimization algorithms and their application to physical design automation. This course enables students to decompose large mapping problem into pieces, including logic optimization with partitioning, placement and routing.

Course Pre/co-requisites

A8429 – CMOS VLSI Design
A8505 – Data Structures

2. Course Outcomes (COs)

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

A8463.1 Analyze the concepts of Physical Design Process such as partitioning, Floor-planning, Placement and Routing,simulation and synthesis.
A8463.2 Analyze physical design problems and employ appropriate automation algorithms for partitioning, floor planning, placement and routing.
A8463.3 Analyze the different types of simulation mechanisms.
A8463.4 Solve the performance issues in circuit layout.
A8463.5 Apply the optimization techniques for different tasks involved in high level synthesis.

3. Course Syllabus

Introduction To VLSI Design Flow: VLSI design automation tools- algorithms and system design. Structural and logic design.Transistor level design. Layout design. Verification methods. Design management tools.

Layout, Placement and Partitioning: Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning.

Floor planning and Routing: Floor planning concepts, Shape functions and floor plan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

Simulation and Logic Synthesis: Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

High Level Synthesis: Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

4. Books and Materials

Text Books:

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
3. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World Scientific 1999

Reference Books:

1. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.
2. M.Sarrafzadeh, " Introduction to VLSI Physical Design", McGraw Hill (IE), 1996

Course Structure

A8464 - Sensors and Actuators

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed with an aim of educating students in micro technology and its use to fabricate sensor systems, the significance of sensors and actuators in the real world are introduced to the students. The students will also able to understand how to fabricate some of those sensors and provide an understanding on modern day micro sensors and micro actuators. This course covers topics on fundamental and applications of several different types of sensors and actuators that are extensively utilized in mechatronic systems and also standard communication protocols between sensors, actuators, and control units will be covered. Further, students will have an idea about how to simulate some of those sensors and characterize before fabricating it.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8464.1 Identify basics of sensors, actuators and their operating principles.
A8464.2 Make use of micro-processing techniques for designing and developing sensors and actuators.
A8464.3 Examine the importance of interfacing sensors and signal conditioning circuits to establish any control system or monitoring system.
A8464.4 Analyze the simulation and its characterization of different sensors.
A8464.5 Apply the characteristic parameters to evaluate sensor performance.

3. Course Syllabus

Sensors: Difference between sensor and transducer, Primary measuring elements selection and characteristics (Range, resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band), Signal transmission, Types of signal (Pneumatic signal, Hydraulic signal, Electronic Signal), Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

Inductive & Capacitive Transducer: Inductive transducers - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: Principle of

operation, construction details, characteristics of Capacitive transducers, different types & signal conditioning and its Applications (capacitor microphone, capacitive pressure sensor, proximity sensor).

Actuators: Definition, types and selection of Actuators (linear, rotary, logical and continuous actuators), Pneumatic actuator, Electro-Pneumatic actuator, cylinder, rotary actuators, mechanical actuating system, Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. **Electrical actuating systems:** Solid-state switches, Solenoids, Electric Motors- Principle of operation and its applications (D.C motors - AC motors - Single phase & 3 Phase Induction Motor, Synchronous Motor, Stepper motors - Piezoelectric Actuator).

Micro Sensors and Micro Actuators: Micro Sensors - Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. **Micro Actuators:** Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

Sensor Materials and Processing Techniques: Materials for sensors - Silicon, Plastics, metals, ceramics, glasses, nano materials. **Processing techniques:** Vacuum deposition, sputtering, chemical vapour deposition, electroplating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

4. Books and Materials

Text Books:

1. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.
2. Sergej Fatikow and Ulrich Rembold, " Microsystem Technology and Microbotics", First edition, Springer –Verlag NEwyork, Inc, 1997.
3. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010

Reference Books:

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997.
4. Manfred Kohl, "Shape Memory Actuators", first edition, Springer

Course Structure

A8465 - Artificial Neural Networks

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course will introduce the basic principles of artificial neural networks. It will cover simple representation schemes, problem-solving paradigms, constraint propagation, and search strategies and also covers the basic neural network architectures and learning as well as reasoning algorithms.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8465.1 Make use of the basic model of artificial neuron and compare the functions of both artificial neuron and biological Neuron.

A8465.2 Develop different architectures of Artificial Neural Networks and apply learning laws and the learning rules associated with the neural networks.

A8465.3 Analyze single layer feed forward neural networks.

A8465.4 Analyze various parameters in the design process of multi layer perceptron to optimize the performance.

A8465.5 Analyze the problem of linearly separable using Perceptron model and relate to the concept of Madaline networks.

3. Course Syllabus

Introduction to Artificial Neural Networks: Introduction, Artificial Neural Networks, Historical Development of Neural Networks, Biological Neural Networks, Comparison Between Brain and the Computer, Comparison Between Artificial and Biological Neural Networks, Network Architecture, Setting the Weights, Activation Functions, Learning Methods.

Fundamental Models of Artificial Neural Networks: Introduction, McCulloch: Pitts Neuron Model, Architecture, Learning Rules, Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule (Widrow-Hoff Rule or Least mean Square (LMS) rule, Competitive Learning Rule, Boltzmann Learning, Memory Based Learning.

Single Layer Perceptron: Introduction, Single Layer Perceptron Architecture, Algorithm, Application Procedure, Perception Algorithm for Several Output Classes, Perceptron Convergence Theorem.

Multilayer Perceptron: Brief Introduction to Multilayer Perceptron networks, Back Propagation Network (BPN), Generalized Delta Learning Rule, Back Propagation rule, Architecture, Training Algorithm, Selection of Parameters, Learning in Back Propagation, Application Algorithm, Local Minima and Global Minima, Merits and Demerits of Back Propagation Network.

Self-Organization Maps (SOM): Introduction, self orgnisation Map, SOM algorithm, Properties of Feature Map, Learnigng Vector Quantization-Architecture, Training Algortihm, Variants of LVQ. **Adaline and Madaline Networks:** Introduction, Adaline Architecture, Algorithm, Applications, Madaline, Architecture, MRI Algorithm.

4. Books and Materials

Text Books:

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa (2006), Introduction to Neural Networks using MATLAB 6.0, Tata McGraw-Hill, New Delhi.
2. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI edition.

Reference Books:

1. B. Yegnanarayana (2007), Artificial Neural Networks, Prentice Hall of India, New Delhi

Course Structure

A8466 - Optical Communications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Optical telecommunications has revolutionized the way where information is received and communicated with one another. This course will provide an understanding of the fundamental principles of optical fiber communication systems. It commences with a description of optical fiber propagation characteristics and transmission properties. We will then consider light sources and the fundamental principles of laser action in semiconductors and other lasers including quantum well lasers, tunable lasers, and fiber lasers, and also the characteristics of optical transmitters based on semiconductor and electro-optic modulation techniques. The characteristics of optical amplifiers will also be discussed. On the receiver side, the principles of photodetection and optical receiver sensitivity will be presented.

Course Pre/co-requisites

A8418 - Electromagnetic Theory and Transmission Lines
A8422- Digital Communications

2. Course Outcomes (COs)

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

A8466.1. Analyze the constructional parameters of optical fibers for improving the efficiency.
A8466.2. Design optical fibres making use of signal distortion.
A8466.3. Analyze the characteristics of fiber optics to design optical detectors.
A8466.4. Design a fiber optic based system using budgets methods.
A8466.5. Apply splicing techniques and mode of fibres to optical communications.

3. Course Syllabus

Overview of Optical Fiber Communication: Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers. Single Mode Fibers- Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index, Fiber Materials Glass, Halide, Active Glass, Chalgenide Glass, Plastic Optical Fibers.

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering, and Bending Losses, Core and Cladding Losses, Information Capacity Determination, Group Delay, Types of Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion,

Intermodal Dispersion, Pulse Broadening, Optical Fiber Connectors- Connector Types, Single Mode Fiber Connectors, Connector Return Loss.

Fiber Splicing: Splicing Techniques, Splicing Single-Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints. Source to Fiber Power Launching: Output Patterns, Power Coupling, Power Launching, Equilibrium Numerical Aperture, Laser Diode to Fiber Coupling.

Optical Detectors: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation-Fundamental Receiver Operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, Probability of Error, Quantum Limit, Analog Receivers.

Optical System Design: Considerations, Component Choice, Multiplexing, Point-to-Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion in Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, and Eye Pattern.
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4. Books and Materials

Text Books:

1. Optical Fiber Communications – Gerd Keiser, MC GRAW HILL EDUCATION, 4th Edition, 2008.
2. Optical Fiber Communications – John M. Senior, Pearson Education, 3rd Edition, 2009

Reference Books:

1. D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005.
2. S.C.Gupta, Optical Fiber Communication and its Applications, PHI, 2005

Course Structure

A8467 - Low Power VLSI Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces various strategies and methodologies for designing low power circuit. It describes the many issues facing designers at architectural, logic, circuit and device levels and presents some of the techniques that have been proposed to overcome these difficulties. This course is a dynamic research area driven by battery–powered portable computing and wireless communications products. It has become critical to the continued progress of high–performance and reliable microelectronic systems. The course addresses the concepts, principles and techniques to reduce the power in VLSI systems.

Course Pre/co-requisites

A8429– CMOS VLSI Design

2. Course Outcomes (COs)

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

A8467.1 Analyze the sources of power dissipation in MOSFET .
A8467.2 Examine the power estimation techniques using various approaches in low power circuit design.
A8467.3 Analyze the power optimization and trade-off techniques in digital circuits.
A8467.4 Develop low voltage CMOS circuits using low power design techniques.
A8467.5 Apply the advanced techniques to design low power VLSI circuits.

3. Course Syllabus

Low-Power CMOS VLSI Design: Introduction, Sources of Power Dissipation, Designing for Low Power. Physics of Power Dissipation in CMOS FET Devices- MIS structure, Long Channel and Sub-micron MOSFET, Gate Induced Drain Leakage, Power dissipation in CMOS-Short Circuit and Dynamic Dissipation, Load Capacitance.

Power Estimation in CMOS Circuits: Modelling of signals, Signal Probability Calculation, Probabilistic Techniques for Signal Activity Estimation. Statistical Techniques - Estimating Average Power in Combinational and Sequential Circuits, Estimation of Glitching Power, Power Estimation using Input Vector Compaction, Power Dissipation in Domino CMOS.

Synthesis for Low Power: Behavioral Level Transforms - Algorithm Level Transforms, Power Constrained Least Squares Optimization for Adaptive and Non-adaptive Filters, Circuit Activity Driven Architectural Transformations, Architecture Driven Voltage Scaling, Power Optimization using Operation Reduction and Substitution, Precomputation-Based

Optimization for Low Power, Logic and Circuit Level Optimization for Low Power.

Design and Test of Low Voltage CMOS Circuits: Introduction, Circuit Design Styles, Leakage Current in Deep Sub - micrometer Transistors, Deep Sub-micrometer Device Design Issues, Minimizing Short Channel Effect, Low Voltage Circuit Design Techniques - Reverse Vgs, Steeper Subthreshold Swing, Multiple Threshold Voltages, Multiple Supply Voltages.

Advanced Techniques: Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuits. **Software Design for Low Power:** Introduction, Sources of Software Power Dissipation, Software Power Estimation and Optimization.
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4. Books and Materials

Text Books:

1. Kaushik Roy, Sharat C. Prasad, Low-Power CMOS VLSI Circuit Design, Wiley India, New Delhi, 2000.
2. Gary Yeap, Practical Low Power Digital VLSI Design, Springer Science, Business Media New York, 1998

Reference Books:

1. Anantha P. Chandrakasan, Robert W. Brodersen, Low - Power CMOS Design, IEEE Press, USA, 1998.
2. Christian Piguet, Low-Power CMOS Circuits: Technology, Logic Design and CAD Tools, CRC Taylor & Francis, USA, 2006

Course Structure

A8468 - System on Chip Architecture

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

System-on-Chip (SoC) architecture involves consolidating various electronic system components onto a single chip. Students in this field explore the integration of processors, memory, interfaces, and specialized hardware. Emphasis is placed on design methodologies, processor architectures, memory hierarchy, communication protocols, power efficiency, testing, and security considerations. The study extends to real-world applications across industries, addressing trends like AI integration and advanced manufacturing processes. SoC architecture plays a pivotal role in powering diverse electronic devices, making it a key focus in modern electronics education.

Course Pre/co-requisites

A8425 - Microcontrollers

2. Course Outcomes (COs)

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

A8468.1 Expected to understand SOC Architectural features.
A8468.2 Acquire the knowledge on processor selection criteria and limitations
A8468.3 cquires the knowledge of memory architectures on SOC.
A8468.4 Understands the interconnection strategies and their customization on SOC.
A8468.5 Design the required hardware & software modules and integrate to be a functional model.

3. Course Syllabus

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I , and D – Caches , Multilevel Caches, Virtual to real translation , SOC Memory System , Models of Simple Processor –

memory interaction.

Interconnect Customization: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization.

Configuration: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

4. Books and Materials

Text Books:

1. Computer System Design System-on-Chip by Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber –2 nd Eed., 2000, Addison Wesley Professional

Reference Books:

1. 1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers

Course Structure

A8469 - Bio Medical Signal Processing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course is designed to give the basic concepts of signal processing involved in medical field and human physiology. It introduces the basic signal processing techniques in analyzing biological signals and students can develop the students mathematical, scientific & computational skills related to the field of biomedical signal processing. This course describes ECG Signal Processing and analysis for parameter estimation of ECG waveforms. It gives an overview of ECG Data reduction techniques and EEG signal.

Course Pre/co-requisites

A8408 - Signals and Systems
A8429 - Digital Signal Processing

2. Course Outcomes (COs)

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

A8469.1 Knowledgeable of the basic signal processing techniques in analyzing biological signals.
A8469.2 To possess the basic mathematical & computational skills necessary to analyse biomedical signals.
A8469.3 Formulate and solve basic problems in biomedical signal analysis is enhanced.
A8469.4 Aware of the complexity of biological signal and the impact, promise of biomedical engineering in understanding these signals.
A8469.5 Demonstrate to effectively communicate their ideas in terms of biomedical signal parameters.

3. Course Syllabus

Introduction to Biomedical signals: Bio-signal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

ECG Signal Processing: ECG data acquisition, ECG lead system, ECG parameters and their estimation, ECG QRS detection techniques: Template matching, differentiation based QRS detection techniques. Estimation of R-R Interval: Finite first difference method. The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording.

ECG Data Reduction Techniques: direct data compression techniques, direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm and FAN algorithm, other data compression techniques: data compression by DPCM, data compression method comparison.

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Realtime ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation.

4. Books and Materials

Text Books:

1. Rangaraj M Rangayyan ,"Biomedical Signal Analysis" –, IEEE Press, 2001
2. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
3. Biomedical Digital Signal Processing – Willis J Tomkins, PHI, 1993.

Reference Books:

1. Biomedical Signal Processing- Principles and Techniques – D.C.Reddy, Tata McGraw-Hill, 2005.

Course Structure

A8470 - Wireless Sensor Networks

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Wireless Sensor Networks (WSNs) introduces the fundamental concepts of sensing technologies, network architectures, and communication protocols essential for designing and deploying sensor networks. It covers the architecture of sensor nodes, energy consumption considerations, and operating environments, along with physical layer fundamentals including modulation, wave propagation, and MAC protocols. The course explores critical aspects such as naming, addressing, and time synchronization techniques to ensure efficient network operation and Security challenges specific to WSNs are also analyzed.

Course Pre/co-requisites

A8454 – Computer Communication Networks.

2. Course Outcomes (COs)

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

A8470.1 Apply knowledge of enabling technologies and application scenarios to design and implement wireless sensor network solutions.

A8470.2 Analyze the architecture and hardware components of wireless sensor networks to evaluate energy consumption and optimize network performance.

A8470.3 Apply fundamental concepts of physical layer communication and MAC protocols to design efficient wireless sensor network communication schemes.

A8470.4 Examine different addressing and time synchronization techniques in wireless sensor networks to ensure reliable network operation.

A8470.5 Analyze security challenges and apply appropriate protocols to safeguard wireless sensor networks against various attacks.

3. Course Syllabus

Introduction to Wireless Sensor Networks: Sensing and Sensors, Challenges and Constraints for wireless sensor networks, Application Examples, Types of Applications. Enabling technologies for wireless sensor networks.

WSN Architectures: Single-node architecture, hardware components, energy consumption of sensor nodes, operating systems and execution environments, **Network architecture:** sensor network scenarios, optimization goals and figures of merit, gateway concepts.

Physical Layer: Introduction, Wireless channel and communication fundamentals: Frequency allocation, Modulation and demodulation, Wave propagation effects and noise. Physical layer and transceiver design considerations in WSNs. **MAC Protocols-** Fundamentals

of wireless MAC protocols, Low duty cycle protocols and wakeup concepts, Contention based protocols.

Naming and Addressing: Fundamentals, Address and name management in wireless sensor networks, Assignment of MAC addresses. **Time Synchronization:** Introduction to the time synchronization problem, Protocols based on sender/receiver synchronization, Protocols based on receiver/receiver synchronization.

Security: Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks. Protocols and Mechanisms for Security, IEEE802.15.4 and ZigBee Security.

4. Books and Materials

Text Books:

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Waltenegus Dargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley & Sons Publications, 2011

Reference Books:

1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor NetworksTechnology, Protocols, and Applications”, John Wiley, 2007.
2. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007.

Course Structure

A8471 - High Speed VLSI Design

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces various strategies and methodologies for high speed systems. It describes multiple issues which are faced by designers at architectural, logic, circuit and device levels. It also presents various techniques being proposed to overcome the difficulties in hierarchical design. The methods of clock distribution and clock generation are also discussed for the design of high–performance and reliable microelectronic systems. The course addresses the concepts, principles and techniques for high speed in VLSI design.

Course Pre/Co-requisites

A8429 – CMOS VLSI Design

2. Course Outcomes (COs)

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

A8471.1. Explore the circuits and techniques involved in high speed VLSI design
A8471.2. Make use of various logic styles to design high speed VLSI circuits
A8471.3. Analyze design-driven performance variability, storage element designs and related issues
A8471.4. Apply various chip interface techniques for high speed circuits
A8471.5. Apply clocking styles for high speed VLSI circuits

3. Course Syllabus

Non Clocked Logic Styles: Static CMOS, DCVS Logic, Non-Clocked pass Gate Families. **Clocked Logic Styles:** Introduction, Single-Rail Domino Logic Styles, Dual-Rail Domino Structures, Latched Domino Structures, Clocked pass Gate Logic.

Circuit Design Margin and Design Variability: Introduction, Process Induced Variations, Design Induced Variations, Application Induced Variations, Noise.

Latching Strategies: Introduction, Basic Latch Design, Latching Differential Logic, Race Free Latches for Pre-charged Logic, Asynchronous Latch Techniques.

Interface Techniques: Introduction, Signaling Standards, Chip-to-Chip Communication Networks, ESD Protection, Driver design techniques, receiver design techniques

Clocking Styles:: Introduction, Clock Jitter, Clock Skew, Clock Generation, Clock Distribution, Asynchronous Clocking Techniques.

4. Books and Materials

Text Books:

1. Kerry Bernstein, Keith M. Carrig & et Al., "High Speed CMOS Design Styles", Kluwer Academic Publishers, 2002

Reference Books:

1. Howard Johnson & Martin Graham, "High Speed Digital Design" A Handbook of Black Magic, Prentice Hall PTR, 1993.
2. William S. Dally & John W. Poulton, "Digital Systems Engineering", Cambridge University Press, 1998.
3. Masakazu Shoji, "High Speed Digital Circuits", Addison Wesley Publishing Company, 1996.

Course Structure

A8472 - IoT Security and Gateways

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is to expose students new developments in the areas of cyber security for the Internet of Things (IoT). As the Internet of Things (IoT) continues to grow the number of privacy and security concerns and issues also increases. To become a professional in this field, it is essential to understand the potential security risks and how to best mitigate them by learning the security and privacy issues in IoT environments. We will explore the organizational risks posed by IoT networks, and the principles of IoT device vulnerabilities also look at software and hardware IoT Applications for industry. With billions of devices tracking our every move, privacy is a critical issue so you will be explored to the social and commercial implications the IoT brings to society.

Course Pre/co-requisites

A8436 - IoT Architectures and Protocols

2. Course Outcomes (COs)

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

A8472.1. Determine the most appropriate IoT Devices and Sensors based on Application.
A8472.2. Analyze the concepts of IoT Network Architecture and design.
A8472.3. Design and implement cryptography algorithms.
A8472.4. Analyze network security problems in various networks.
A8472.5. Build security systems using elementary blocks and cloud based IoT systems.

3. Course Syllabus

Introduction to Internet of Things: Genesis of IoT, IoT and Digitization, IoT impact: Connected Roadways, Connected factory, Smart Connected Buildings, Convergence of IT and OT, Drivers Behind New Network Architectures: Scale, Security, Constrained Devices and Networks, Data, Legacy Device Support.

IoT Network architecture and Design: One M2M IoT Standardized Architecture, The IoT World Forum Standardized Architecture, A Simplified IoT architecture, The Core IoT Functional stack: "Things" layer, Communications Network layer, Access Network Sublayer, Gateways and Backhaul Sublayer, Network Transport Sublayer, Applications and Analytics layer, IoT Data management and Compute Stack.

Fundamentals of Encryption for Cyber Security: Cryptography – Need and the Mathematical basics- History of cryptography, symmetric ciphers, block ciphers, DES – AES. Public-key cryptography: RSA, Diffie-Hellman Algorithm, Elliptic Curve Cryptosystems, Algebraic structure, Triple Data Encryption Algorithm (TDEA) Block cipher.

IoT Security Framework: IoT security frame work, Security in hardware, Boot process,OS Kernel, application, run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

Elementary blocks of IoT Security Models for Identity Management: Vulnerability of IoT and elementary blocks of IoT Security, Threat modeling – Key elements, Identity management Models and Identity management in IoT, Approaches using User centric, Device-centric and Hybrid, Cloud security , Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud.

4. Books and Materials

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",Cisco press,2017.
2. William Stallings, "Cryptography and Network security: Principles and Practice", 5th Edition,2014, Pearson Education, India.
3. Parikshit Narendra Mahalle, Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, 2015.
4. Alasdair Gilchrist, "IoT security Issues", Oreilly publications, 2017

Reference Books:

1. John R. Vacca, "Computer and Information Security Handbook", Elsevier, 2013.
2. Christof Paar and Jan Pelzl, "Understanding Cryptography – A Textbook for Students and Practitioners", Springer, 2014.
3. Maryline Laurent, SamiaBouzefrane, "Digital Identity Management", Elsevier, 2015

Course Structure

A8473 - Electronic Measurements and Instrumentation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides an overall understanding of the elements and processes, including sources of errors, and digitally acquiring these measurements. Along with an overview of instrumentation principles, the physical principles and electrical characteristics for several common instrument transducers are studied. The electronic signal conditioning circuits required for converting the electrical changes in the transducers to signal which can be interpreted accurately by a microprocessor or an embedded controller are analyzed effectively. This course also gives an integration of hardware and software in designing computer controlled processes and/or systems with the aid of sensors, transducers, data acquisition board, and instrument control.

Course Pre/co-requisites

A8415 – Analog Electronic Circuits

2. Course Outcomes (COs)

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

A8473.1 Demonstrate the acquired knowledge of Ammeter, Voltmeter, Multimeter and performance characteristics of electrical & non- electrical instruments to design various measuring devices.

A8473.2 Apply different methods of transducers to measure various non-electrical parameters.

A8473.3 Inspect the functional operation of oscilloscopes, signal analyzers for the measurement of various signals and lissajous patterns.

A8473.4 Analyze the various AC and DC bridge circuits to find unknown values of R, L, C to minimize errors in measurements.

A8473.5 Apply Data Acquisition Systems for Instrumentation in industrial applications

3. Course Syllabus

Characteristics of Instruments: Block schematic of measuring system, Performance characteristics of instruments-static and dynamic characteristics, Errors in measurement. **Measuring Instruments:** DC voltmeters – multirange, range extension, solid state and differential voltmeters, DC Ammeter - multirange, range extension, Arytonshunt, ohmmeters-series type and shunt type, AC Voltmeter. **Digital Voltmeters:** Dual slope and Successive Approximation type DVM.

Cathode Ray Oscilloscope (CRO): Introduction to CRT, Vertical amplifiers, horizontal deflection system, simple CRO. **Special Purpose Oscilloscopes:** Dual beam CRO, Dual trace oscilloscope, sampling oscilloscope, analog storage oscilloscope, digital storage oscilloscope, measurement of phase and frequency (lissajous patterns).

DC and AC Bridges: Introduction to DC and AC Bridges, Measurement of resistance Wheat's stone bridge, Kelvin's double bridge, measurement of Inductance using Maxwell's inductance bridge, Anderson's bridge, measurement of capacitance using Schering bridge, Wagner's ground connection, errors, and precautions in using bridges.

Transducers: Classification, selecting a transducer, Resistive transducer, Resistive position transducer, Strain Gauges: Bounded, unbounded; LVDT, instrumentation amplifier, photo voltaic cell, thermistors, sensistors.

Measurement OF Non - Electrical Quantities: Measurement of displacement, Measurement of Humidity, Velocity, Force, Pressure, Temperature -Measurements, analog and digital data acquisition systems, interfacing and bus standards, programmable logic controllers and its industrial applications.

4. Books and Materials

Text Books:

1. H.S.Kalsi, Electronic Instrumentation, 3rd edition, Tata McGraw-Hill Education
2. K Sawhney (2007), Electrical and Electronic Measurements and Instrumentation, 18th edition, Dhanpat Rai & Co, New Delhi.

Reference Books:

1. D. Helfrick, W.D. Cooper (2002), Modern Electronic Instrumentation and Measurement Techniques, 5th edition, Prentice Hall of India, New Delhi.
2. David A. Bell (2003), Electronic Instrumentation & Measurements, 2nd edition, Prentice Hall of India, New Delhi.
3. D.V.S Murthy (2004), Transducers and Instrumentation 1st edition Prentice Hall of India, New Delhi.

Course Structure

A8474 - 5G and Beyond Communications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is intended to stress the fundamentals of wireless communications engineering that are important to any mobile communication system. It introduces Spectrum Challenges in 5G, Hardware Technologies for mmW Systems and various generations of wireless systems. It covers various types of radio access techniques in mobile radio environment. This course describes the 5G functional and physical architecture and its requirements. This course explains architecture, Beamforming and hardware technologies for mmW communications. This course also deals with requirements and fundamental techniques for MTC and D2D Communication.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8474.1. Apply Spectrum utilization methods in higher bandwidth wireless communications to increase the efficiency of communication system.

A8474.2. Analyze Device to device communication and millimeter wave communication standards for industry applications.

A8474.3. Analyze the multiple access techniques and standards for the development of wireless networking and reducing interferences.

A8474.4. Apply radio propagation technologies to provide enhanced performance in massive 5G communications.

A8474.5. Apply future Mobile Technologies and protocols in massive MIMO systems for better performance in 5G systems.

3. Course Syllabus

Multiple Input Multiple Output (MIMO) Communications: Spatial Multiplexing, Spatial Diversity, Beamforming in MIMO systems, Hybrid Precoding, 5G Communication Landscape, Related work on 5G.

Introduction to Mobile Wireless Technology Generations: 5G, WISDOM, GIMVC, Requirements of 5G, standardization of WISDOM, Vision of 5G, WISDOM Concept and Challenges, Cellular D2D Communication, D2D Using Physical Layer Network Coding, Using FFR and Using Cognitive Radio. **SMNAT:** Introduction, Network Architecture and the Process, Implementation of SMNAT for In-Band-D2D and Interoperability with WISDOM, Description of Network elements of SMNAT and Call Flow for Session Establishment.

Radio Wave Propagation for mmWave: Introduction, Large-scale Propagation Channel Effects, Small-Scale Channel Effects, Spatial Characterization of Multipath and Beam Combing, Outdoor Channel Models, Indoor Channel Models.

Higher layer Design Considerations for mmWave: Challenges when Networking Mm Wave Devices, Beam Adaptation Protocols, Relaying for Coverage Extension, Support for Multimedia Transmission, Multiband considerations, Performance of Cellular networks, mmWave Standardization: ECMA-387, IEEE 802.11ad.

Beyond 2020: Major Challenges Surrounding Future Cyber Security, Users Awareness, Spectrum Related Security Issues in CRNs. Challenges for 2020 and beyond, Future Mobile Technologies, High Altitude Stratospheric Platform Station Systems, Human Bond Communications, CONASENSE.

4. Books and Materials

Text Books:

1. Ramjee Prasad, 5G: 2020 and Beyond , River Publishers
2. T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, Millimeter Wave Wireless Communication, Pearson Education , 2015.

Reference Books:

1. M. Manish, G. Devendra, P. Pattanayak, and N. Ha, 5G and Beyond Wireless Systems PHY Layer Perspective, Springer Series in Wireless Technology
2. M. Vaezi, Z. Ding, and H. V. Poor, Multiple Access techniques for 5G Wireless Networks and Beyond, Springer Nature, Switzerland, 2019

Open Electives

Course Structure

A8181 - Smart Cities

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The purpose of this course is to provide a deep understanding about smart and sustainable cities. The course will begin with the basic concepts and theories of urbanization and elements. The course will cover the global practices in the smart cities and technologies in shaping new and existing cities. The course will include the feasibility for smart cities and financing approaches for urban development. The course will also include the role of electric vehicles and energy rating system for smart cities.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8181.1 Interpret the concepts, history and evolution of smart cities.
A8181.2 Identify the elements of smart city such as smart people, smart living, smart economy, smart infrastructure, smart governance and smart environment.
A8181.3 Analyze the concepts, discourses and practices of smart cities across globe.
A8181.4 Develop the road map for planning smart cities and benchmarking their performance for Indian context.
A8181.5 Apply relevance for smart cities of developing economies considering issues as inclusiveness, feasibility and sustainability.

3. Course Syllabus

Introduction to Smart and Sustainable Cities: Concepts and theories of Urbanization, City Planning, Emergence of Sustainability, Liveability, Green to Smart Cities; Understanding smart cities – Concepts, History and Evolution of Smart Cities.

Dimensions of Smart Cities: Elements of Smart City – Smart People, Smart Living, Smart Economy, Smart Infrastructure, Smart Governance, Smart Environment.

Global Experience of Smart Cities: Case studies from European, Middle East and Asian Contexts, specifically cases of Barcelona, Amsterdam, Majhdhar, and Singapore, Review of Global Standards.

Smart City Planning and Development: How to plan for smart cities, Concepts of Retrofitting, Redevelopment, Extension and Pan city approaches, Review of Smart financing approaches, Tools, concepts of special purpose vehicles, Land pooling-based financing approaches of urban development.

Sustainable Development in Smart Cities: Energy storage and utilization, role of electric vehicles, autonomous vehicles in urban mobility, Green Audit, Energy saving system.

4. Books and Materials

Text Books:

1. M.Barlow and C. Levy-Bencheton. Smart Cities, Smart Future: Showcasing Tomorrow
2. Gassmann, J.Böhm Smart Cities: Introducing Digital Innovation to Cities

Reference Books:

1. UN-Habitat; Inclusive and sustainable urban planning: a guide for municipalities; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4)
2. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science
3. Draft Concept Note on Smart City Scheme. Government of India - Ministry of Urban Development.

Course Structure

A8182 - Disaster Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course has been framed with an intention to provide a general concept in the dimensions of disasters caused by nature beyond human control as well as the disasters and environmental hazards induced by human activities with emphasis on Natural disaster, Man-made disaster, vulnerability and risks of disasters, Disaster Management Mechanism, Capacity Building and disaster coping Strategies and Disaster management planning.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

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

A8182.1 Identify basic concepts of hazards, vulnerabilities and risks of disaster phenomena.
A8182.2 Interpret various types of disasters and disaster coping strategies.
A8182.3 Examine Disaster Impacts and suggest suitable capacity building frame work for disaster management.
A8182.4 Select appropriate steps in Disaster management cycle for Disaster Risk Reduction.
A8182.5 Develop Strategies for disaster management planning and sustainable development.

3. Course Syllabus

Introduction: Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation, disaster phenomena, events global National & Regional.

Disasters: Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile

of India, Covid 2019 in India, mountain and coastal areas, ecological fragility, coping with disaster- strategies, safety norms & survival kits.

Disaster Impacts: Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters, capacity building – concepts, assessment –structural & non-structural measures, legislative support.

Disaster Risk Reduction: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Disasters, Environment and Development: Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environment friendly recovery; reconstruction and development methods.

4. Books and Materials

Text Books:

1. Manual on Disaster Management, National Disaster Management Authority, Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2017.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India.

Reference Books:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.

Course Structure

A8183 - Environmental Pollution Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The course has been designed to improve the understanding of the students about different pollution control strategies and the skills of application of remediation techniques to combat pollution in three environmental compartments i.e., air, water and soil. The course will also be dealing about the sources of pollution in air, soil, water, and noise and the impacts these sources on the environment and health. In addition, the students will be given the knowledge to develop the particular skills required in pollution related structured research and environmental management.

Course Pre/co-requisites

A8032 - Environmental Science and Technology

2. Course Outcomes (COs)

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

A8183.1 Identify water pollution sources, types and treatment methods.
A8183.2 Apply knowledge on Prevention and control of air pollution.
A8183.3 Inspect sources, effects and mitigation methods of noise pollution.
A8183.4 Examine soil pollution sources, effects and control measures.
A8183.5 Develop Environmental management plan to minimize environmental pollution.

3. Course Syllabus

Water pollution: Water Pollution - Introduction - Sources and types of water pollutants Physical, Chemical and Biological. Ground water - Surface water - lake water - seawater. Effects of water pollution. Water Quality standards (Drinking and Industrial) - water treatment - physical, chemical and biological. Water Pollution Prevention and Control Act, 1974.

Air pollution: Structure and composition of atmosphere – classification, sources and effects of air pollution – Acid rain – greenhouse effect – global warming – Ozone depletion, Prevention and control of air pollution particulate control – settling chamber, scrubber, bag filter, cyclones electrostatic precipitators. Gaseous emission control methods. Air pollution

prevention and control Act 1981.

Noise Pollution: Noise Pollution Basics of acoustics- propagation of indoor and outdoor sound- noise profiling effects of noise – measurement, index and mitigation methods- health effects of noise- Vibration and its Effects, Whole body vibration problems in opencast mines-ground vibration and Air blast. Green Belt Development–Principles and design considerations, Industrial Noise Pollution Control methods.

Soil Pollution: Sources - solid waste disposal and their effects - pesticides - types and effect of pollutants on Plants - animals and human beings - biomagnification - fertilizers and its Effect of pollutants on plants - animals and human beings - soil pollution Control measures - soil microbes and function - biofertilizer.

Environmental management: Environmental impact assessment and statement; Government strategies in pollution control: subsides, polluter pays principle and regulations; Government Agencies and Programs – The Tiwari committee – creation of NCEPC, Department of Environment & Forest – Function of State Pollution Control Board. Sources of environmental information and regulations; Sustainable development and environmental protection.

4. Books and Materials

Text Books:

1. C. S. Rao, Environmental Pollution Control Engineering, 3^{rd} Edition, New Age International Pvt Ltd, 2018.
2. Rao, M. N and H.V.N. Rao, Air Pollution, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2017.
3. Kudesia, V.P and Ritu Kudesia, Water Pollution, Pragati Prakashan Publication, Meerut, 2017.
4. Murphy, E., King,E., Environmental Noise Pollution, 1^{st} Edition , Amsterdam : Elsevier, 2014.

Reference Books:

1. H.S Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, Indian Edition, McGraw Hill Education (India) Pvt Ltd, 2014.
2. De Nevers, N., Air Pollution Control Engineering, 3^{rd} edition, Waveland Press Inc 2017.
3. Sagar Pal Singal, Noise Pollution and Control Strategy, 2^{nd} Edition, Alpha Science International Ltd, 2005.

Course Structure

A8155 - Green Building and Sustainability

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces concepts of sustainability in the context of construction building materials. It also discusses the role of low carbon cements and recycled aggregate in minimizing consumption of natural resources. The course also emphasizes the concepts of embodied, operational, life cycle energy and minimizing energy consumption. It also intends to make students aware of rating systems like LEED, GRIHA etc.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8155.1 Identify green building and green building materials.
A8155.2 Make use of different rating agencies to classify the type of building.
A8155.3 Analyze sustainability and its implications for the practice of engineering.
A8155.4 Evaluate the potential of the alternative construction materials for sustainability.
A8155.5 Examine the green building rating systems and its contribution to sustainability.

3. Course Syllabus

Green Building: Concept of Green building, Principles of green buildings, Eco-friendly materials, Certification systems – Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED).

Green Building Materials: Green Building Materials and Equipment in India, what are key requisites for Constructing a Green Building, Important Sustainable features for Green Building. **Building Services:** Fire protection – classes of fire and causes, development of fire, fire resisting materials, means of escape, Standing Fire Advisory Council norms. Water supply -Water distribution and plumbing fixtures.

Applications in the Built Environment: Concepts of green buildings, climate responsive building - Reduction of energy consumption, direct and indirect methods - Reduction of water consumption, direct and indirect methods - Carbon footprint and eco footprints of buildings - New concepts and trends in green buildings, national and international.

Sustainability: The Concept of Sustainability; Definition of Sustainability, Dimension of Sustainability. Three Pillars of Sustainability, Principles of Sustainability - 5R, Construction Materials Resource Efficiency, Operational Reuses of the Construction Materials, Sustainability Goals for construction Industry.

Sustainability in Built Environment: Environmentally sensitive design, low impact development, green infrastructure and conservation design, Green buildings and land use planning, Energy use and buildings.

4. Books and Materials

Text Books:

1. Frederick S. Merritt, Jonathan T. Ricketts, Building design and construction Handbook, McGraw-Hill Inc., 5^{th} edition,1994.
2. Fred hall and Roger Greeno, Building Services Handbook, Routledge, 7^{th} edition, 2013.
3. Bradley A. Striebig, Adebayo A. Ogundipe and Maria Papadakis, Engineering Applications in Sustainable Design and Development, 1^{st} edition, 2016.

Reference Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

Course Structure

A8224 - Electric Vehicles

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the fundamental concepts, principles, architectures and analysis of electric vehicles. Student will explore the working principle of electric vehicles, delve into key roles played by motors as propulsion systems and requirements for battery and its management systems. In addition to this, focuses on various charging systems and charging infrastructure. This course also emphasizes the EV business and the future trends in the development of electric vehicles.

Course Pre/co-requisites

A8213-Electrical Machines-II

2. Course Outcomes (COs)

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

A8224.1. Infer the electric vehicle system and its impact on environment.
A8224.2. Analyze the various hybrid vehicle configurations and its performance.
A8224.3. Interpret the electric drives used in hybrid and electric vehicles.
A8224.4. Choose proper energy storage systems for electric vehicle applications.
A8224.5. Identify the different charging systems and charging infrastructure for EVs.

3. Course Syllabus

Introduction To Electric Vehicles: EV System: EV Configuration-Fixed & variable gearing, single & multiple motor drive, In-wheel drives. Components of an EV, Components of ICEVs, EV History, the early years, recent EVs and HEVs, Types of EVs, EV Advantages, Comparison of EVs and ICEVs w.r.t to efficiency, pollution, capital & operating cost.

Hybrid Electric Vehicles: Types of Hybrids Vehicles- Series, parallel, series-parallel and complex HEVs, Advantages and Disadvantages of HEVs, Concept of Hybrid Electric Drive Trains, Architectures and power flow control of Hybrid Electric Drive Trains.

Electric Propulsion Systems: Choice of electric propulsion systems, block diagram of EV propulsion system, BLDC Machine Construction and Classification, Basic Principles of

BLDC Motor Drives, application to Electric Vehicles. Switched Reluctance Motor Drives, Basic Magnetic Structure, Torque Production, SRM Drive Converter, Modes of Operation, Generating Mode of Operation.

Introduction To Energy Storage Requirements: Electrochemistry of battery cells, Battery parameters, Types of Batteries- Lead–Acid Batteries, Ni Cd Batteries, NiMH Batteries and Lithium-Ion Batteries. EV Charging: Types of charging systems- Conductive charging On board & off-board charging, inductive charging, Wireless charging.

Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and charge zone. Key Battery Management Technologies, Typical Structure of Battery Management Systems. Business: E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study, E-mobility Indian Roadmap, social dimensions of EVs.

4. Books and Materials

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003
2. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES: Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., 2003
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wi- ley and Sons, 2012.

Reference Books:

1. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wi- ley and Sons, 2012.
2. Reissland, Martin.U (2010), Electrical Measurements: Fundamentals, Concepts, Applications, New Age International (P) Limited, New Delhi.
3. Shen, Weixiang Xiong, Rui, "Advanced battery management technologies for electric vehicles" 2019, John Wiley & Sons

Course Structure

A8281 - Solar Energy and Applications

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students about the solar energy technologies and potentials. The course aims to introduce the concepts of Photo Voltaic cells, their properties, and its societal needs. The applications of solar cells will be explained in detail also the environmental issues of solar systems will be explained. It also covers the economic analysis of a solar energy system and its environmental benefits.

Course Pre/co-requisites

"The course has no specific prerequisite and co-requisites"

2. Course Outcomes (COs)

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

A8281.1. Compare the present and future available electrical power from solar energy based on the knowledge of global solar horizontal irradiation.

A8281.2. Assimilate and acquire the skills for design and engineering of solar thermal and solar photovoltaic technology and systems.

A8281.3. Identify the problems involved in solar thermal energy conversion technique used in the solar heating and cooling systems for buildings/societal needs.

A8281.4. Examine the components of a solar photo voltaic system and their function by utilizing the previous literature knowledge on different photovoltaic solar cells.

A8281.5. Analyze the techno-economics performance and issues in the solar energy system.

3. Course Syllabus

Theory

Principles of Solar Radiation: Role and potential of solar energy, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and Sun shine, solar radiation data.

Solar Energy Collectors: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Different methods of solar energy storage, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating /cooling technique, solar distillation and drying.

Photo Voltaics (PV): Fundamentals of solar cells, types of solar cells, absorption of photons, excitations and photo emission of electrons.
PV Cell Properties: Solar cell properties and design, p-n junction photodiodes, depletion region, electrostatic field across the depletion layer, electron and holes transports, device physics, charge carrier generation, recombination and other losses, I-V characteristics, output power.

Solar Cell Applications:PV cell interconnection, module structure and module fabrication, Equivalent circuits, load matching, efficiency, fill factor and optimization for maximum power, Design of stand-alone PV systems, system sizing, device structures, device construction, DC to AC conversion, inverters.

Cost Analysis and Environmental Issues: Cost analysis and pay back calculations for different types of solar panels and collectors, installation and operating costs, Environmental and safety issues, protection systems, performance monitoring.

4. Books and Materials

Text Books:

1. G. D. Rai (2009), Non-Conventional Energy Sources, 4^{th} Edition, Khanna Publishers, New Delhi.
2. Martin A. Green (2008), Solar Cells: Operating Principles, Technology and system Applications, 1^{st} Edition, Prentice Hall, New Delhi.

Reference Books:

1. B. H. Khan (2016)- Non Conventional Energy Resources-3^{rd} Edition, McGraw Hill Education (India) Private Limited.
2. Sukatme (2008), Solar Energy, 3^{rd} Edition, McGraw Hill Companies, New Delhi.
3. D. Yogi gosuami, Frank Kreith, Jan F. Kreider (2000), Principles of Solar Engineering, 3^{rd} Edition, Taylor & Francis, USA.

Course Structure

A8282 - Energy Storage Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students to impart fundamental knowledge on energy storage systems considering the operation and design of various energy storage devices. This course provides a foundation for understanding the general principles and fundamentals of lithium-ion rechargeable battery engineering, fuel cells and super capacitors.

Course Pre/co-requisites

"The course has no specific prerequisite and co-requisites"

2. Course Outcomes (COs)

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

A8282.1. Apply the knowledge of concepts of science to understand the concepts of electro chemical cell.
A8282.2. Apply the knowledge of electro chemistry to describe the components and process in batteries.
A8282.3. Describe the electrical, thermal, and mechanical behavior of Li-Ion batteries under various operating conditions.
A8282.4. Apply the knowledge of basic science concepts to distinguish various types of fuel cells and their functionalities
A8282.5. Apply the knowledge of science to interpret the operation and characteristics of super capacitors.

3. Course Syllabus

Theory

Battery Technology Overview: Battery definitions, terms and terminology, Primary cells, Secondary cells. Electro chemistry - Electro chemical energy sources, Voltage and potential energy, Reduction and oxidation, Reduction potentials and electro chemical couples.

Battery Construction : Electro chemical cell, Cell mechanical structure, Resistance and polarization, Electrode design, Discharging and charging. Major Battery Chemistries and performance comparison.

Lithium-Ion Batteries: Lithium-ion cell reaction, construction - pouch cells, cylindrical, flexible foil. Principle of operation, Charge and discharge characteristics, State of charge (SOC), State of health (SOH), State of function (SOF), Charging procedures, Safety of

lithium-ion batteries, Lifetime. Types of Lithium-ion Batteries .

Fuel Cells: Introduction – working, performance characteristics and efficiency, types of fuel cell – Alkaline Fuel Cell, Polymer Electrolyte Membrane Fuel Cell, Molten Carbonate Fuel Cell, Solid-Oxide Fuel Cell, hydrogen fuel cells.

Super Capacitors: Introduction, Electro chemical Double-Layer Super capacitors, Charge-Discharge characteristics, Energy and power density, Design Considerations, Stacking and Voltage cell balancing.

4. Books and Materials

Text Books:

1. John Warner, The Handbook of Lithium-Ion Battery Pack Design: Chemistry, Components, Types and Terminology, 1^{st} Edition, Elsevier Science, 2015.
2. 2. Reiner Korthauer, Lithium-Ion Batteries: Basics and Applications, 1^{st} Edition, Springer, 2018.

Reference Books:

1. R. O'hayre, S.W. Cha, W.G. Colella, F.B. Prinz, Fuel Cell Fundamentals, 3^{rd} Edition, Wiley, 2016.
2. Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa, Lithium-Ion Batteries: Science and Technologies, 1^{st} Edition, Springer, 2009.
3. Aiping Yu, Victor Chabot, Jiujun Zhang, Electrochemical Supercapacitors for Energy Storage and Delivery: Fundamentals and Applications, CRC Press, 2013.

Course Structure

A8283 - Power Generation Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Electrical Energy plays a significant role in day-to-day life of entire mankind. This course deals with the generation of power along with its economic aspects. It deals with the basic theory of various conventional power stations and the different components present in them. The course also helps the students to familiarize with different types of substations and its advantages and disadvantages. It also deals with the economic aspects of power system, power factor correction techniques and suitable pricing methods.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8283.1 List the different components of an electric power system.
A8283.2 Categorize the conventional methods of generating electrical power to meet the required load demand.
A8283.3 Categorize the Non-conventional methods of generating electrical power to meet the required load demand.
A8283.4 Model a power system to reduce economic losses.

3. Course Syllabus

Introduction: Conventional Energy Sources and their availability, Non-Conventional Energy Sources and their availability, Environmental impact of conventional and Non-Conventional energy sources.Hydro Electric Power Plants: Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydroelectric plants (mini and micro).

Thermal Power Plant: Site selection, Plant layout, Coal its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines.

Nuclear Power Plant: Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

Non-Conventional Energy: Types of Non conventional Energy generation: solar, wind, tidal, biomass and wave energy.

Economic Aspects of Power Generation and Tariff Methods: Base load and peak load on power station. Interconnected grid system, Load curve, load duration and integrated load duration curves, demand, diversity, capacity, utilization and plant use factors. Costs of electrical energy - Fixed, Semi-fixed and Running Costs, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle. Tariff, Characteristics, Types - Flat Rate, Block-Rate, two-part, three-part, and power factor tariff methods.

4. Text Books:

1. M. L. Soni, P. V. Gupta, U. S. Bhatnagar, A. Chakrabarti (2010), "A Text Book on Power System Engineering", 2nd Edition, Dhanpat Rai & Co. Pvt. Ltd, New Delhi.
2. C. L. Wadhwa (2010), "Generation, Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International (P) Limited, New Delhi.

Reference Books:

1. Leonard L. Grigsby (2012), "Electric Power Generation Transmission and Distribution, 3rd Edition, CRC press.
2. J. B. Gupta (2010), "A Course in Power Systems", 10th Edition, S. K. Kataria & Sons, New Delhi.

Course Structure

A8381 - Hybrid Vehicles

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The Basics of Hybrid Vehicles course introduces fundamental concepts in hybrid technology, combining internal combustion engines with electric propulsion. Students learn about hybrid vehicle architectures, regenerative braking, and battery systems. The curriculum covers energy management strategies, efficiency considerations, and the environmental impact of hybrid vehicles. Practical insights and case studies provide a foundation for understanding the design and operation of hybrid transportation systems.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8381.1 Identify different types of hybrid vehicles and their power train configurations
A8381.2 Analyze the energy management strategy for hybrid vehicles
A8381.3 Develop and optimize the hybrid vehicles subsystems
A8381.4 Apply advanced technologies and materials in hybrid vehicles design
A8381.5 Evaluate the performance and environmental impact of hybrid vehicle.

3. Course Syllabus

Introduction to Hybrid Vehicles:

Overview of hybrid vehicles and their advantages, types of hybrid vehicles (series, parallel, series-parallel), comparison with conventional vehicles and electric vehicles, historical background and evolution of hybrid vehicles, current market trends and future prospects.

Powertrain and Energy Storage Systems: Overview of powertrain configurations for hybrid vehicles, electric motors and their control systems, internal combustion engines and their optimization for hybrid use, energy storage systems (batteries, capacitors, flywheels) and their selection criteria, power electronics and electrical systems for energy conversion and distribution.

Energy Management and Control Systems: Overview of energy management strategies for hybrid vehicles, energy flow diagrams and efficiency maps, control systems for hybrid powertrains (electronic controls, sensors, actuators), algorithm development for optimal energy management, real-time operating systems and software architectures for vehicle control.

Aerodynamics and Thermal Management: Overview of aerodynamic principles relevant to hybrid vehicles, drag reduction techniques and wind tunnel testing, cooling system design and optimization for hybrid vehicles, climate control systems and cabin comfort considerations, NVH (noise, vibration, harshness) management in hybrid vehicles.

Challenges and Opportunities in Hybrid Vehicle Design: Discussion of challenges unique to hybrid vehicle design (e.g., packaging, weight, cost), opportunities for innovation and advancement in hybrid technology, case studies of successful hybrid vehicle designs and their lessons learned, future outlook for hybrid vehicles and their role in sustainable transportation, emerging trends in alternative propulsion technologies (fuel cells, hydrogen fuel cell vehicles, autonomous vehicles)

4. Books and Materials

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management

Reference Books:

1. . M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge.

Course Structure

A8382 - Fundamentals of Robotics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces students to the basics, types and elements of robots. The course exposes students to the theoretical concepts of robot kinematics. Path planning and trajectory planning concepts gives the perception on control of robotics. The concepts on actuators and sensors gives clear understanding and design ability for mobility systems. It gives an overview on application of robotics in manufacturing industry.

Course Pre/co-requisites

A8002 - Ordinary Differential Equations and Vector Calculus

2. Course Outcomes (COs)

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

A8382.1 Illustrate the basic concepts and components of a robotic system
A8382.2 Select appropriate actuators and sensors for designing robot mobility system
A8382.3 Solve transformation problems to describe the robot position and orientation of robot
A8382.4 Apply the concepts of robot work cell design and control
A8382.5 Choose appropriate robots for various applications suitable to modern manufacturing systems.

3. Course Syllabus

Introduction to Robotics: Classification of Robots, Advantages and Disadvantages of Robots, Degree of freedom, joints, Robot coordinates, Robot workspace, Robot characteristics, Robot Components, types of robot arms, end effectors, grippers.

Actuators: Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic and Pneumatic Devices, Electric Motors in Robotics.Sensors: Sensor Characteristics, Position Sensors, Velocity Sensors, Acceleration Sensors, Touch and Tactile Sensors, Proximity Sensors, Range Finder.

Manipulator Kinematics: Specifications of matrices, Homogeneous Transformation, D-H notation, joint coordinates and world coordinates, Forward and inverse kinematics, Simple problems.Path Planning:Trajectory planning and avoidance of obstacles, Path planning, introduction to robot programming.

Robot Work Cell Design and Control: Robot Cell Layouts, Multiple Robots and Machine Interface, Some Consideration in Work Cell Design, Interlocks, Error Detection and Recovery, Robot Cycle Time Analysis.

Robotic Applications: Robots in manufacturing and non- manufacturing applications, Health Service, Intelligent Home Applications, Military Applications, Space Application, Entertainment robots, Service robots, Domestic or household robots.

4. Books and Materials

Text Books:

1. Richard D. Klafter, Robotic Engineering, 2nd Edition, Prentice Hall of India, New Delhi.
2. M.P. Groover, Industrial Robotics, 3rd Edition, Pearson Education, New Delhi.

Reference Books:

1. R.K. Mittal, I.J. Nagrath, Robotics and Control, 1st Edition, Tata Mc Graw Hill, New Delhi.
2. P. Coiffet, M. Chaironze, An Introduction to Robot Technology, 3rd Edition, Kogam Page Ltd,London.
3. Ganesh S. Hegde, A Textbook of Industrial Robotics, 2nd Edition, University Science Press.

Course Structure

A8383 - 3D Printing

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

3D printing is an additive manufacturing process whereby objects are built up from plastic filament, liquid resin, layers of powder, or even bio-compatible and edible materials.Desktop 3D printing is today's printing press, putting rapid prototyping, customizable products, and individualized medical appliances in reach of the general public. Literacy in basic 3D modeling and manufacturing is an essential skill for future STEM success in this country. In this course students will learn how to be "makers" by using various types of 3D modeling software and imaging equipment, printing actual physical objects that they have designed and modeled themselves, and participating in educational outreach in the institute and the community.

Course Pre/co-requisites

A8302 - Computer Aided Drawing

2. Course Outcomes (COs)

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

A8383.1 llustrate the fundamental concepts of Additive Manufacturing and 3-D printing, its advantages and limitations
A8383.2 Apply engineering knowledge, techniques, skills and modern tools to analyze problems in 3D Printing
A8383.3 Appraise additive manufacturing through 3d printing
A8383.4 Solve Complex manufacturing problems for significant technological and societal development
A8383.5 Evaluate engineering products using the knowledge of mathematics, science, engineering and IT tools.

3. Course Syllabus

Introduction to 3D Printing: Fundamental of 3D printing, Need for 3D printing Generic 3d printing process, Distinction between 3D printing and CNC, Classification of 3D printing Processes, Steps in 3D printing process, Advantages of 3D printing, standards for 3D printing, Major Applications. VAT Photo Polymerization 3d Printing Processes: Stereo

lithography (SL), Materials, SL resin curing process, Process Benefits and Drawbacks, Applications of Photo polymerization Processes.

Material and Binder Jetting 3D Printing Processes: Evolution of Printing as a 3D printing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes. Binder Jetting 3d Printing Processes: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, Technical challenges in printing, Applications of Binder Jetting Processes.

Extrusion-Based 3D Printing Processes: Fused Deposition Modeling (FDM), Principles, Materials, Plotting and path control, Bio-Extrusion, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes. Powder Bed Fusion 3d Printing Processes: Selective laser Sintering (SLS), Materials, Powder fusion mechanism, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.

Directed Energy Deposition 3D Printing Processes: Process Description, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Benefits and drawbacks, Applications of Directed Energy Deposition Processes. Wire arc based additive manufacturing methods, Advantages and disadvantages, comparison with conventional 3D printing and WAAM. Post Processing of 3d Printing Parts: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques. Inspection of 3D printing parts: Different destructive and non-Destructive testing of 3D printing parts, acceptance standards for 3D printing parts.

3D Printing Applications: Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defense, automobile, Bio-medical and general engineering industries.

4. Books and Materials

Text Books:

1. Ian Gibson, David W Rosen, Brent Stucker,Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition, Springer.
2. Ali K. Kamrani, EmandAbouel Nasr,Rapid Prototyping: Theory & Practice,2nd Edition, Springer.

Reference Books:

1. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling,1st Edition, Springer.
2. Rafiq Noorani,Rapid Prototyping: Principles and Applications in Manufacturing,1st Edition, John Wiley & Sons.

Course Structure

A8402 - Digital Electronics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to teach students the fundamentals of digital electronics. Starting from learning the basic postulates of Boolean algebra, to cover map method for simplifying Boolean expressions, to outline the formal procedures for the analysis and design of combinational and sequential circuits, to design combinational and sequential programmable devices. These digital components are the basic building blocks from which more complex digital systems are constructed.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8402.1. Apply fundamental theorems and properties of Boolean algebra to simplify a Boolean function.
A8402.2. Apply the map method to obtain simplified and optimized logical expressions.
A8402.3. Build combinational circuits using logic gates for real time digital systems.
A8402.4. Analyze the behaviour of latches and flipflops for designing sequential logic. .
A8402.5. Make use of programmable logic devices in the design of digital systems.

3. Course Syllabus

Boolean Algebra and Logic Gates: Introduction, basic definitions, axiomatic definition of Boolean algebra, basic theorem and properties, Boolean functions, canonical and standard forms, digital logic gates.

Gate-Level Minimization: The map method, two-variable, three-variable and four-variable K-maps, sum-of-products, product-of-sums simplification, don't-care conditions, NAND and NOR implementation.

Combinational Logic: Combinational circuits, analysis procedure, design procedure, binary adder-subtractor, magnitude comparator, decoders, encoders, multiplexers, demulti-

plexers.

Synchronous Sequential Logic: Sequential circuits, storage elements – latches and flip-flops, analysis of clocked sequential circuits. **Registers and Counters:** Registers, shift registers, ripple counters, synchronous counters.

Memory and Programmable Logic: Random-Access Memory, read-only memory, programmable logic array, programmable array logic.

4. Books and Materials

Text Books:

1. M. Morris Mano, Michael D. Ciletti (2017), Digital Design With an introduction to the Verilog HDL, 6thEdition, Pearson Education/ PHI, India

Reference Books:

1. Ronald J Tocci, Ronald J Tocci, Neal S Widmer , Gregory L Moss , Digital Systems - Principles an Applications , 10th Edition, Pearson Education International
2. Charles H RothJr, Larry L Kinney, Fundamentals of Logic Design,6th Edition, Cengage Learning

Course Structure

A8481 - Basic Electronics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course covers fundamental topics that are common to a wide variety of analog and digital electronics. This course starts with basics of semiconductors, review the operation and characteristics of semiconductor devices (namely, semiconductor diodes and BJTs), and buildup to more advanced topics in analog circuit designs.

Course Pre/co-requisites

A8006 - Applied Physics.
A8204 - Basic Electrical Engineering.

2. Course Outcomes (COs)

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

A8481.1 Analyze the operation and characteristics of electronic devices.
A8481.2 Construct electronic circuits making use of diodes and transistors.
A8481.3 Analyze single stage amplifiers using small signal low frequency transistor model.
A8481.4 Analyze the effect of negative and positive feedback on amplifiers.
A8481.5 Design single stage amplifier for given specifications.

3. Course Syllabus

Diode and its Characteristics: P-N junction diode, operation in forward and reverse bias conditions, V-I characteristics, Zener diode and its characteristics, rectifiers - half wave, full wave and bridge rectifiers (simple problems), Filters (qualitative treatment), voltage regulation using Zener diode.

Transistors: Bipolar Junction Transistor (BJT) - construction, operation, CE, CB and CC transistor configurations and characteristics. **BJT Biasing:** Need for biasing, operating point, load line analysis, biasing and stabilization techniques: fixed bias, collector to base bias, self-bias.

BJT Amplifiers: Transistor as an amplifier, BJT h-parameter model, analysis of transistor amplifier using h- parameter model, CE, CB and CC amplifiers, comparison of CB, CE and CC configurations, Simplified h parameter model.

Feedback Amplifiers Concept of feedback, classification of feedback amplifiers, general Characteristics of negative feedback amplifiers, effect of negative feedback on input and output resistances.

Oscillators: Condition for oscillations, RC Phase shift oscillator with transistor, Wein bridge oscillator, Hartley and Colpitts oscillator.

4. Books and Materials

Text Books:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th Edition, PHI, 2013.
2. Jacob Milliman, Christos C .Halkias, Satyabrata Jit (2011), Electronic Devices and Circuits, 3rd edition, Tata McGraw Hill, New Delhi

Reference Books:

1. G.K.Mittal (1999), Electronic Devices and Circuits, 22nd edition, Khanna Publications, New Delhi
2. S. Shalivahanan, N. Suresh Kumar, A. Vallavaraj (2007), Electronic Devices and Circuits, 3rd edition, McGraw Hill, New Delhi, India.

Course Structure

A8482 - Principles of Communication Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides a foundation in the theoretical aspects of Electronic Communication Systems. This course focuses on Analog and Digital Communications, Pulse and Data Communications. This course forms the basis for the study of advanced communication systems like Telephone Switching networks, Computer Communications, Radar Communications, Cellular and Mobile Communications, Optical Communications and Satellite Communications.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8482.1 Summarize the fundamental concepts and acquire competencies for each topic of analog and digital modulation techniques.

A8482.2 Illustrate elements of analog, digital and data communications systems and identify their real-time applications.

A8482.3 Compare analog and digital communication systems with respect to performance parameters and applications.

A8482.4 Analyze the error control and coding techniques including Source Coding Technique, Huffman Source Coding, Error Control, and Coding.

A8482.5 Distinguish the features of advanced communication systems.

3. Course Syllabus

Introduction to Electronic Communications: Historical Perspective, Electromagnetic Frequency Spectrum, Signal and its Representation, Elements of Electronic Communications System, Primary Communication Resources, Signal Transmission Concepts, Analog and Digital Transmission, Modulation, Concept of Frequency Translation, Signal Radiation and Propagation, Classification and Sources of Noise, Signal-to-Noise Ratio (SNR), Noise Figure.

Principles of Analog Communication: Types of Analog Modulation, Principles of Amplitude Modulation, AM Power Distribution, Limitations of AM, DSBSC Modulation, SSB Modulation, Vestigial-Sideband Modulation, Comparison of Analog Modulations, Applications, Principles of Angle Modulation, Theory of FM—Basic Concepts, Spectrum Analysis, Narrowband and Wideband FM, Theory of Phase Modulation, Relationship between FM and PM, Comparisons and Applications of FM and PM.

Sampling Theorem and Pulse Modulation Techniques: Digital Versus Analog Transmissions, Sampling Theorem, Classification of Pulse-Modulation Techniques: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse-Code Modulation (PCM), Quantization of Signals, Delta Modulation, Comparison of PCM Techniques, Vocoders.

Digital Modulation Techniques and Information Theory: Types of Digital Modulation, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Phase Shift Keying, M-Ary PSK, Quadrature Amplitude Modulation, Minimum Shift Keying, Information, Entropy and Its Properties, Channel Capacity Theorem, Objectives of Source Coding, Source Coding Technique, Huffman Source Coding, Error Control and Coding.

Advanced Communication Systems: Spread Spectrum Communication: General Model, Features, Multiple Access techniques, Telephone Switching, Computer Communications, Optical Communications, Mobile Communications-the Cellular Concept, Satellite Communications, RADAR systems.

4. Books and Materials

Text Books:

1. T L Singal, "Analog and Digital Communications", 1st edition, Tata McGraw-Hill, 2012
2. H. Taub, D L Schilling and G Saha, "Principles of Communication Systems", 3rd Edition, Tata McGraw-Hill, 2008.

Reference Books:

1. George Kennedy, Electronic Communication Systems, Tata McGraw-Hill.
2. B. P.Lathi, "Modern Analog and Digital Communication Systems", 3rd Edition, Oxford University Press, 2007.

Course Structure

A8483 - Fundamentals of IoT

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces you to Advance concepts and design techniques for creating Internet of Things systems and applications, as well as programming languages and tools optimized for the IoT industry. Participants are also exposed to new IoT-specific applications, physical layer protocols, communication technologies, and legacy protocols. This course will primarily present the fundamental IOT architecture building blocks and its theoretical components, such as Raspberry Pi programming using the Python Language Interface and other IOT peripherals.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8483.1 Identify the basic building blocks and its characteristics.
A8483.2 Determine the most appropriate IoT Devices and Sensors based on Application.
A8483.3 Make use of Python standard libraries for implementing various IoT Applications.
A8483.4 Analyze the appropriate protocol for establishing communication between various IoT Devices.
A8483.5 Interpret cloud infrastructure, services, APIs and architectures of commercial and industrial cloud platforms.

3. Course Syllabus

Introduction to Internet of Things: Introduction, Physical Design of IoT, Logical Design of IoT, IoT enabled Technologies, IoT Levels and Templates, IoT Platforms Design Methodology.

Introduction to Python: Language features of Python, Data types & data structures, Control of flow, Functions, Modules, Packages, File Handling, Data/Time operations, Classes, Python packages of interest for IoT(JSON,XML).

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, IoT System Management with NETCONF- YANG-Need for IoT Systems Management, SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG.

IoT Physical Devices and Endpoints: Introduction to IoT Device, Exemplary Device: Raspberry Pi, Components of Raspberry Pi Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming – Raspberry Pi with Python.

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs,WAMP – AutoBahn for IoT, Xively Cloud for IoT, ThingSpeak IoT Python web application framework-Django, Designing a RESTful web API.

4. Books and Materials

Text Books:

1. ArshdeepBahga and Vijay Madisetti: Internet of Things,A Hands-on Approach; University Press, 2016
2. Mark Lutz, "Learning Python", 4th edition, OREILLY, 2009.

Reference Books:

1. Getting Started with Raspberry Pi:Matt Richardson & Shawn Wallace,O'Reilly (SPD), 2014.

Course Structure

A8484 - Introduction to Embedded Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Introduction to Embedded systems course introduces the basic concepts like purpose and quality attributes of embedded systems. It covers the differences between the general purpose computers and specific purpose computers and selection of memory according to the requirement for a system. This course presents ASICs, PLDs, COTS, Memory Interface, and communication interface. This course provides a comprehensive introduction to microcontroller (8051) and their architecture with an emphasis on its interfacing with external devices. Focus is on 8051 microcontroller family which includes internal architecture, pin diagram, instruction set, register organization, addressing modes, operating modes, interrupt structure, assembly language programming and etc. Various aspects of hardware design, such as interfacing of memory and different types of I/O devices will be covered in detailed.

Course Pre/co-requisites

A8401 - Digital Logic Design.
A8416 - Computer Organization and Microprocessors.

2. Course Outcomes (COs)

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

A8484.1 Classify the embedded systems based on the performance, complexity and the era in which they evolved.
A8484.2 Understand different factors to be considered for the selection of memory, sensors, actuators and their interfacing.
A8484.3 Apply the fundamentals of microcontroller to investigate existing designs.
A8484.4 Demonstrate assembly language programming to assemble and driver circuitry to microcontroller I/O ports to interface external devices.
A8484.5 Develop a product with functional requirements using optimal hardware and software components.

3. Course Syllabus

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing,

Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

The 8051 Architecture: Introduction, 8051 micro controller hardware, external memory interfacing, Data transfer and logical instructions, arithmetic operations, decimal arithmetic, jump and call instructions and simple programs. The Assembly Language Programming: Programming tools and techniques, counter and timers programming, interrupts, interrupt programming.

I/O Interfaces: 8051 interfacing with seven segment LED displays, stepper motor, D/A converter interfacing, Interfacing DC motor, Interfacing 4*4 Matrix Keypad, Interfacing to Alphanumeric Displays (LCD) interfacing.

Basic Design Using a Real-Time Operating System: Tasks and Task states, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment, Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System.

4. Books and Materials

Text Books:

1. Introduction to embedded systems Shibu K V Tata Mcgraw-Hill First Edition 2012
2. Kenneth J. Ayala (2008), The 8051 Microcontroller, 3rd edition, Cengage Learning, India.
3. David E. Simon (1999), An Embedded Software Primer, Pearson Education, India

Reference Books:

1. M. A. Mazidi J. G. Mazidi, Rolin D. McKinlay (2000), The 8051 Microcontroller and Embedded System, Prentice Hall of India, New Delhi.
2. Ajay V. Deshmukh (2004), Microcontrollers Theory and applications, Tata McGraw Hill Edition, New Delhi
3. Embedded Systems Rajkamal Tata Mcgraw-Hill Second Edition 2012

Course Structure

A8510 - Operating Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Operating Systems is a graduate-level introductory course that teaches the concepts in operating systems like abstractions, mechanisms, and various services provided. This course deals with Process Management & Synchronization, Inter process communication, Memory Management, Virtual Memory, File & Disk Management and Deadlock handling methods. Using these concepts, the student will be able to understand the internal working of various operating systems. The course provides the concepts and terminology required for advanced courses.

Course Pre/co-requisites

A8506 - Computer Organization

2. Course Outcomes (COs)

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

A8510.1. Identify the services provided by the operating system for user and system.
A8510.2. Examine the concepts of IPC and Synchronization for process cooperation
A8510.3. Make use of Memory Management techniques for efficient use of main memory.
A8510.4. Select File and Disk Management methods for effective storage and access.
A8510.5. Identify a Deadlock Handling Method in allocating resources among processes.

3. Course Syllabus

Operating Systems Overview and Process Management: Definition, Operating System Types, Operating System operations, Operating system services, System calls and System Programs. Process concepts- Process, Process State Diagram, PCB and Operations on processes, Process Scheduling- Scheduling Criteria, Scheduler Types and Scheduling Algorithms.

Process Synchronization: Inter Procee Communication- Pipes, Message Passing and Shared Memory. Concept of Synchronization, Critical section problem, Peterson's solution,

Semaphores, Classic problems of Synchronization-The Bounded Buffer Problem, The Readers –Writers Problem, Dining - Philosophers Problem.

Memory Management: Introduction to Memory Management, Swapping, Contiguous Memory Allocation, paging, segmentation, virtual memory, demand paging, Page-replacement algorithms, allocation of frames, thrashing.

File and Disk Management: Concept of a file – File Attributes, File Types, Access Methods, Directory Structures, File System Implementation, Directory Implementation, File Allocation methods, and Free-Space management. Introduction to Magnetic Disks, Disk Structures, Disk Scheduling, Swap Space Management.

Deadlocks: System Model, Deadlock Characterization-Necessary Conditions, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance - RAG Algorithm, Banker's Algorithm, Detection- Single Instance ofa Resource type, Multiple Instances of a resource type, recovery from deadlock.

4. Books and Materials

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne., Operating System Concepts, 8th Edition, Wiley India Private Limited, New Delhi,2009.

Reference Books:

1. William Stallings., Operating Systems, Internals and Design Principles, 5th Edition, Pearson Education, India, 2006.
2. Sumitabha Das., Your Unix the Ultimate Guide, Tata Mc Graw Hill, New Delhi, India, 2007.
3. T.Chan., Unix System Programming using C++, PHI, India,1996.

Course Structure

A8514 - Database Management Systems

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces the core principles and techniques required in the design and implementation of database systems. This course focus on relational database management systems, including database design theory: E-R modeling, query languages like relational algebra, relational calculus and SQL. It also covers essential DBMS concepts such as: Normalization, Transaction Processing, Concurrency Control, Recovery and tree based indexing techniques like ISAM, B+ trees etc which are required for designing an effective database. Students can undertake a semester project to design, build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Pre/co-requisites

A8608 - Java Programming

A8601 - Object Oriented Programming

2. Course Outcomes (COs)

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

A8514.1. Design a database for a given problem using E-R diagrams and Relational Model.
A8514.2. Construct Queries in Relational algebra and SQL for a case study.
A8514.3. Use Normalization techniques to reduce data redundancy in data base.
A8514.4. Select transaction control and recovery methods to keep data base consistent.
A8514.5. Compare various indexing techniques and NoSQL databases for efficient access.

3. Course Syllabus

Introduction and Data Base Design: Introduction to DBMS, applications of DBMS, database systems versus file systems, view of data, Database users and administrators, database system structure. Introduction to Relational database model, database schema, relations, columns and tuples. SQL data types, Database languages, DDL commands, DML commands, DCL commands, TCL commands. Database Design: Introduction to ER model, entities, attributes and entity sets, relationships and relationship sets, additional features of

the E-R model. logical database design: E-R to relational.

SQL Programming: SQL basic operators, SQL set operators-union, intersect and except operators, Integrity constraints in SQL. aggregate operators, GROUP BY, ORDER BY and HAVING Clause, null values, views in SQL, nested queries, SQL joins-inner join, outer join, left outer join, right outer join, storing and retrieving images, storing and retrieving files, Relational algebra operations and basic queries.

Schema Refinement and Normal Forms: Introduction to schema refinement & Normalization, Decomposition and properties of decompositions, functional dependencies, Closure of Attributes set. Normal forms: 1NF, 2NF, 3NF, BCNF, 4NF,5NF. Problems on normalization, Schema refinement in database design. PL/SQL basics for writing triggers, cursors.

Transaction Management: Transaction concept, transaction states, ACID properties, schedules, Serializability-Conflict serializability, View serializability, recoverability. Concurrency control: lock based protocols, timestamp based protocols, deadlocks handling. SQL stored procedures.

Indexing and NoSQL: :Recovery-ARIES recovery algorithm, Log based recovery. File organization techniques, Tree index structures: ISAM and B+ trees. SQL Vs NoSQL, basic CRUD operations using MongoDB.

4. Books and Materials

Text Books:

1. Raghurama Krishnan, Johannes Gehrke., Database Management Systems, 3rd Edition, Tata McGraw-Hill, New Delhi, India, 2014.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan., Database System Concepts, 7th Edition, McGraw- Hill, New Delhi, India, 2019.

Reference Books:

1. Elmasri Navate., Fundamentals of Database Systems, Database System Concepts, 7th Edition, Pearson Education, India,2016.
2. C. J. Date, A. Kannan and S. Swamynathan., An Introduction to Database Systems, 8th Edition, Pearson Education, India, 2015.

Course Structure

A8520 - Software Engineering

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course acts as a foundation in the field of software engineering and is aimed at helping students develop an understanding of how software systems are developed from basic, by guiding them through the development process, adopting the fundamental principles of system development. The course will orient the students to the different software process models, software requirements engineering process, systems analysis and design as a problem-solving activity, with focus on quality.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8520.1. Identify the design issues and process models to develop a software.
A8520.2. Determine the functional and non functional requirements with appropriate validation for a software product.
A8520.3. Develop software design documents for the given requirements.
A8520.4. Prepare test documents at various stages to validate project.
A8520.5. Illustrate the need of quality management and metrics for product standardization

3. Course Syllabus

Introduction to Software Engineering: The Evolving nature of software engineering, Changing nature of software engineering, Software engineering Layers, The Software Processes,Software Myths. Process Models: A Generic Process Model, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Spiral Model, the Unified Process.

Requirements Engineering: Functional and Non-Functional Requirements, The Software requirements Document, Requirements Specification, requirements Engineering, Requirements Elicitation and Analysis, Requirement Validation, Requirement Management.

Design and Implementation: System Modeling: Interaction Models, Structural Models, Behavioral Model, Model Driven Engineering. The Object Oriented Design with UML, Implementation Issues. User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

Software Testing Strategies: A Strategic approach to Software Testing, Strategic Issues and Test Strategies for Conventional Software, Validation Testing, Unit Testing , Integration Testing, Regression Testing , The Art of Debugging, White Box Testing - Basic Path Testing, Control Structure Testing. Black Box Testing - Equivalence partitioning, Boundary value analysis, Graph Based testing and state transition testing.

Quality Management: Quality Concepts, Software Quality, Software Quality Dilemma, Achieving Software Quality, Review Techniques, Reviews: A Formal spectrum, Informal Reviews, Formal Technical Reviews. Software Quality Assurance: Background Issues,Elements of Software Quality Assurance, Tasks, Goals and Metrics, Software Reliability,the ISO 9000 Quality Standards.

4. Books and Materials

Text Books:

1. Roger S. Pressman.,Software Engineering, A Practitioner's approach , 7th Edition, McGraw Hill International Edition, New Delhi,2011.
2. Sommerville., Software Engineering, 9th Edition,Pearson education, India.

Reference Books:

1. K. K. Agarval, Yogesh Singh., Software Engineering, 3rd Edition, New Age International Publishers, India,2007.
2. Lames F. Peters, Witold Pedrycz, Software Engineering an Engineering approach,John Wiely & Sons, New Delhi, India,2000.
3. Shely Cashman Rosenblatt., Systems Analysis and Design, 6th Edition, Thomson Publications, India.

Course Structure

A8607– Information Security

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Information security is the practice of protecting information by mitigating risks across computer systems. The course introduces the technical and policy foundations of information network security. This course explains the inner workings of cryptographic systems and how to correctly use them in real-world applications.

Course Pre/co-requisites

A8519 - Computer Networks.

2. Course Outcomes (COs)

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

A8607.1 Recognize various security threats, services, mechanisms, and classical encryption techniques.
A8607.2 Apply classical encryption algorithms (Substitution and Transposition ciphers) and DES, AES algorithms to encrypt plain text.
A8607.3 Explain various key management techniques, exemplifying RSA and Diffie-Hellman.
A8607.4 Examine the problems of authentication techniques (SHA, Digital signature).
A8607.5 Analyze different symmetric key distribution and understanding of various authentication applications

3. Course Syllabus

Introduction to Information Security: Computer security concepts, OSI security architecture,security attacks, security services, security mechanisms, a model for network security.Classical Encryption Techniques: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques.

Block Cipher and Data Encryption Standards: Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles, tools used for DES.Advanced Encryption Standards: Advanced Encryption Standard, Finite Field Arithmetic, AES Structure, AES Transformation Functions, AES Key Expansion, tools used for AES.Blowfish Algorithm,International Data Encryption Algorithm(IDEA).

Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, extended Euclid's algorithm. Public-Key Cryptography

and RSA: Principles of Public key crypto Systems, RSA algorithm, Diffie-Hellman Key Exchange.

Hash Functions: Cryptographic Hash Functions, Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA). Digital Signature: Digital Signature Requirements, Attacks and Forgeries, Properties.

Key Management and Distribution : Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security Email Security:Pretty Good Privacy (PGP).

4. Books and Materials

Text Books:

1. William Stallings, Cryptography and network security: principles and Practice Upper Saddle River: Pearson, 6th edition.

Reference Books:

1. Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (Sie).McGraw-Hill Education, 2011.
2. AtulKahate., Cryptography and Network Security, 2nd edition, Tata Mc-Grawhill, India,2008.

Course Structure

A8608 - Java Programming

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides Object Oriented Programming concepts using Java. The course focuses on different aspect of core Java Environment suitable to write efficient, maintainable, and portable code. It also ignites Object Oriented thinking and explores with the evolution of Java and its basics. It provides strong foundation on Inheritance, Packages and Interfaces and also illustrates Exception Handling and Multithreaded mechanisms. It also provides Collection framework for manipulating data. This course also focuses on file handling using Java API.

Course Pre/co-requisites

A8505 - Data Structures

A8508 - Python Programming Laboratory

2. Course Outcomes (COs)

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

A8608.1 Make use of various constructs to write a console application.
A8608.2 Use principles of OOP to develop real time applications.
A8608.3 Identify the need of exception handling to deal with runtime errors.
A8608.4 Build applications for parallel processing using Multithreading.
A8608.5 Choose Collection framework and I/O to manipulate and store data.

3. Course Syllabus

Introduction to OOP : Evolution of Java, OOP principles, Java Buzzwords, Implementing Java program, JVM, Data Types, Variables, Type conversions and Casting, Operators, Control statements, Arrays. Classes, Objects, Methods, Constructors, this keyword, Overloading Methods and Constructors, Argument passing, Exploring String class.

Inheritance, Interfaces and Packages: Inheritance- Inheritance Basics, Using super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Abstract classes, final keyword. Packages and Interfaces: Defining a Package, Finding Packages and CLASSPATH,

Access Protection, Importing Packages, Defining and Implementing interfaces, Extending interfaces.

Exception Handling: Exception Handling Fundamentals, Exception Types, using try catch, throw throws and finally keywords, Built-in Exceptions, Creating own exception subclasses.

Multithreading: Multithreading: Multithreading- Life cycle of a thread, Thread class methods, creating threads, thread priorities, Synchronizing threads, Interthread Communication.

Collections and I/O : Collections - Introduction to Collection Framework, Collections Hierarchy, ArrayList, LinkedList, HashSet, TreeSet. The Date and StringTokenizer. I/O – Basics, reading and writing console input and output, PrintWriter class, operations of files – reading, writing and copying files.

4. Books and Materials

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, Tata McGraw-Hill Education, 2019.

Reference Books:

1. Y.Daniel Liang, Introduction to Java Programming-Comprehensive Version, 10th Edition,Pearson Education,2018.
2. Kathy Sierra, Bert Bates, OCA Java SE 8 Programmer, 1st Edition, McGraw-Hill Education, 2017.

Course Structure

A8651 - Ethical Hacking

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Ethical hacking strikes all of us as a subject that requires a great deal of prerequisite knowledge about things like heavy duty software, languages that includes hordes of syntaxes, algorithms that could be generated by maestros only. Well that's not the case, to some extent. This course introduces the steps required to complete a penetration test, or ethical hack. Requiring no prior hacking experience, the book explains how to utilize and interpret the results of modern day hacking tools that are required to complete a penetration test. Coverage includes GoogleHacking, Nmap, Nessus, Metasploit, and Hacker Defender rootkit. Simple explanations of how to use these tools and a fourstep methodology for conducting a penetration test provide readers with a better understanding of offensive security.

Course Pre/co-requisites

A8519-Computer Networks

2. Course Outcomes (COs)

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

A8651.1 Use the various security tools to assess the computing system.
A8651.2 Identify the vulnerabilities across any computing system using penetration testing.
A8651.3 Choose a prediction mechanism to prevent any kind of attacks.
A8651.4 Make use of metasploit tool to probe systematic vulnerabilities on networks and servers.
A8651.5 Identify the wireless network flaws and fill security patches in web access.

3. Course Syllabus

Introduction to Hacking: Important Terminologies, Penetration Test, Vulnerability Assessments versus Penetration Test, Pre-Engagement, Rules of Engagement, Penetration Testing Methodologies, OSSTMM, NIST, OWASP, Categories of Penetration Test, Types of Penetration Tests, Vulnerability Assessment Summary Reports.

Information Gathering Techniques: Information Gathering Techniques, Active Information Gathering, Passive Information Gathering, Sources of Information Gathering, Information Gathering with Whois, Tracing the Location, Traceroute, ICMP Traceroute, TCP Traceroute, Usage, UDP Traceroute, Enumerating and Fingerprinting the Webservers, Google Hacking.

Network Attacks: Vulnerability Data Resources, Exploit Databases, Network Sniffing, Types of Sniffing, Promiscuous versus Nonpromiscuous Mode, MITM Attacks, ARP Attacks, Denial of Service Attacks, Hijacking Session with MITM Attack, SSL Strip: Stripping HTTPS Traffic, DNS Spoofing, ARP Spoofing Attack Manipulating the DNS Records, DHCP Spoofing, Remote Exploitation, Attacking Network Remote Services, Overview of Brute Force Attacks, Traditional Brute Force, Attacking SMTP.

Exploitation: Introduction to Metasploit, Reconnaissance with Metasploit, Port Scanning with Metasploit, Compromising a Windows Host with Metasploit, Client Side Exploitation Methods, e- Mails with Malicious Attachments. .

Wireless and Web Hacking: Wireless Hacking, Introducing Aircrack, Cracking the WEP, cracking a WPA/WPA2 Wireless Network Using Aircrack-ng, Brute Force and Dictionary Attacks, Types of Authentication.

4. Books and Materials

Text Books:

1. Rafay Baloch., Ethical Hacking and Penetration Testing Guide, CRC Press, 2014.

Reference Books:

1. Kevin Beaver, Ethical Hacking for Dummies,6th Edition,Wiley, 2018.
2. Jon Erickson., Hacking: The Art of Exploitation, 2nd Edition, Rogunix, 2007.

Course Structure

A8652 - Cyber Security

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides a comprehensive overview of various cybercrimes, how they are planned, possible vulnerabilities and crimes that occur in mobile and wireless devices. It introduces tools and techniques that are used in cybercrime. It helps in analyzing and designing defensive security mechanisms for protecting information systems resources.

Course Pre/co-requisites

A8519- Computer Networks
A8607- Information Security

2. Course Outcomes (COs)

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

A8652.1 Identify the cybercrimes and offences in network accesses.
A8652.2 Interpret the criminal plans before going to attack.
A8652.3 Choose various security measures on mobile devices for a given scenario and make an effective report.
A8652.4 Identify the various methods and tools in Cyber Crime.
A8652.5 Examine various defense and analysis techniques to protect our information from attackers

3. Course Syllabus

Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, who are Cybercriminals, Classifications of Cybercrimes. Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.

Cybercrime -Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Defense and Analysis Techniques: Memory Forensics - Why Memory Forensics Is Important, Capabilities of Memory Forensics, Memory Analysis Frameworks, Dumping Physical Memory, Installing and Using Volatility, Finding Hidden Processes, Volatility Analyst Pack, Honey pots, Intrusion Detection Systems.

4. Books and Materials

Text Books:

1. Nina Godbole and Sunil Belapure., Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Prespectives,1st Edition,Wiley INDIA, 2011.
2. James Graham, Richard Howard and Ryan Otson., Cyber Security Essentials,1st Edition,CRC Press,2011.

Reference Books:

1. Chwan-Hwa(John), Wu,J.David Irwin., Introduction to Cyber Security,1st Edition, CRC Press T and F Group, 2013.
2. Richard A. Clarke, Robert Knake., Cyberwar: The Next Threat to National Security and What to Do About It,Ecco 2010.

Course Structure

A8656 - Blockchain Technology

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries, and is predicted to be just as impactful as the Internet. A blockchain is a permanent, sequential list of transaction records distributed over a network. The course introduces consensus, proof of work, mining, in Bitcoin. The course introduces ethereum blockchain and smart contracts.

Course Pre/co-requisites

A8607 - Information Security

2. Course Outcomes (COs)

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

A8656.1 Identify the basic concepts of block chain to process data
A8656.2 Make use of Bitcoin as cryptocurrency
A8656.3 Choose Ethereum block chain for security
A8656.4 Design smart contracts as per the requirements and deploy on Testnet works.

3. Course Syllabus

Introduction to Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency. How Bitcoin Achieves Decentralization: Centralization vs. Decentralization, Distributed Consensus, Consensus without Identity: the Block Chain, Incentives and Proof of Work, Putting It All Together.

Mechanics of Bitcoin: Bitcoin Transactions, Bitcoin Scripts, Applications of Bitcoin Scripts, Bitcoin Blocks, The Bitcoin Network, Limitations Improvements. Store Usage: How to Store and Use Bitcoins, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Bitcoin Mining: The Task of Bitcoin Miners, Mining Hardware, Energy Consumption Ecology, Mining Pools, Mining Incentives and Strategies. Bitcoin and Anonymity: Anonymity Basics, How to de-anonymizeBitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, Tor and the Silk Road.

Ethereum: What is Ethereum, smart contracts, Solidity Ethereum Virturalmachine. Installing solidity ethereum wallet, basics of solidity by example, Layout of a solidity source file

structure of smart contracts, General value types, ether units, Time units, Globally available variables and functions.

Operators: Arithmetic, Logical Bitwise operators, Control structure (if-else, for, while, do-while), Scoping and declarations, Input parameters and output parameters, Function calls return types, Function Modifiers, Fallback functions, Abstract contract, Creating contracts via new operator, Inheriting smart contracts, Importing smart contracts compiling contracts, Events logging, exceptions, Examples of smart contract : crowd funding, voting ballot.

4. Books and Materials

Text Books:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., Goldfeder, S.,Bitcoin and cryptocurrency technologies: a comprehensive introduction, Princeton University Press, 2016.
2. Dave Hoover, Kevin Solorio, and Randall Kanna., Hands–On Smart Contract Development with Solidity and Ethereum, O'Reilly Media, Inc., 2019.

Reference Books:

1. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 1st Edition, O'Reilly Media, Inc., 2019.

Course Structure

A8658 - Robotic Process Automation

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

RPA is an advanced form of business process automation that can provide a path for businesses to automate human actions. RPA is ultimately about automating some of the most mundane and repetitive computer-based tasks and processes in the workplace like text, image automation with sequence of actions, keyboard-based automation, and E-mail automation etc. Process automation is able to record tasks performed by a human on their computer, then perform those same tasks without human intervention.This course will help Students to learn how to Automate the Tasks in real time.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8658.1. Discuss use of RPA platform and its components.
A8658.2. Apply sequence and control flows as per the requirements.
A8658.3. Analyse data manipulation concepts to solve real time problems.
A8658.4. Illustrate user interface explorer and handle events.
A8658.5. Demonstrate scenario of handling the errors and exceptions and benefits of RPA.

3. Course Syllabus

Introduction to Robotic Process Automation: Scope and techniques of automation, Benefits of RPA, Components of RPA, RPA platforms, About UiPath. Record and Play: UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio,Task recorder, Step-by-step examples using the recorder.

Sequence & Control Flow: Sequence, Flowchart, and Control Flow, Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-Step example using Sequence and Flowchart, Step-by step example using Sequence and Control flow.

Data Manipulation: Variables and scope, Collections, Arguments-purpose and use,Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example).

Handling events: Element triggering events, image triggering events, system triggering events, PDF Extraction, Revisit Recorder: Basic recording, Desktop recording, web recording, Screen Scraping, Automation Techniques: Incoming Email automation, Sending Email automation, Workbook and Excel automation (read/write).

Error and Exception Handling: Exception handling, Common exceptions and ways to handle them,debugging techniques, Collecting crash dumps, Error reporting. Future of RPA,RPA Compared to BPO, BPM and BPA

4. Books and Materials

Text Books:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940.
2. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA System, Publisher: A press,2020.

Reference Books:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant.
3. SrikanthMerianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

Web Resources:

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

Course Structure

A8681 - E-Commerce

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The tremendous growth of the Internet and World Wide Web is making a great impact on businesses, governments and individuals throughout the world. In this course, students will understand the phenomena, technological, economic and social, behind these rapid changes, and how organizations successfully conduct Internet-based activities. This course discusses some of the technology of the Internet. This course provides an overview of e-commerce from both technological and managerial perspectives. It introduces e-commerce frameworks and technological foundations; and examines basic concepts such as strategic formulation for e-commerce enterprises, management of their capital structures and public policy. It is particularly important that the students emphasis on understanding the different E-Commerce system design principles.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8681.1. Elaborate the components and roles of the E-Commerce environment.
A8681.2. Estimate how to sell products and services on the web as well as to meet the needs of website visitors.
A8681.3. Analyze the impact of E-commerce on business models and strategy.
A8681.4. Create a portfolio of the steps required to start-up an on-line business.
A8681.5. Interpret legal and ethical issues related to E-Commerce and web marketing approaches.

3. Course Syllabus

Introduction to E-Business and E-Commerce: What is the difference between e-commerce and e-business, Anatomy of E-Commerce applications, E-Business risks and barriers to business adoption, Management responses to E-Commerce and E-Business, Electronic Commerce-Frame work.

E-Commerce Fundamentals: Location of trading in the marketplace, Business models for ecommerce, Focus on auction business models, Focus on Internet start-up companies. E-Business Infrastructure - Introduction, Internet technology, Web technology, Internet-access software applications, Managing e-business infrastructure, Focus on web services, SaaS and service oriented Architecture (SOA), Focus on mobile commerce.

E-Environment: Social and legal factors, Environmental and green issues related to Internet Usage, Focus on e-commerce and globalization, Political factors.
E-Business Strategy - What is e-business strategy, Strategic analysis, Strategic objectives, Strategy definition, Strategy implementation, Focus on information systems strategy and e-business strategy.

E-Security: Securing the Business on Internet- Security Policy, Procedures and Practices, Transaction Security, Cryptology, Digital Signatures, Security Protocols for Web Commerce. Supply Chain Management- What is supply chain management?,Focus on the value chain, Using e- business to restructure the supply chain, Supply chain management implementation

E-Procurement: What is e-procurement, Drivers of e-procurement, Focus on estimating eprocurement cost, implementing e-procurement.

4. Books and Materials

Text Books:

1. Dave Chaffey., E-Business and E-Commerce Management , strategy, Implementation and practice, 5th Edition, Prentice Hall,2011.

Reference Books:

1. E-Commerce fundamentals and applications Hendry Chan, Raymond Lee, Tharam Dillon, Ellizabeth - 215 - Chang, JohnWiley.
2. Whinston,Pearson., Frontiers of electronic commerce –Pearson Education, Kalakata,2015.
3. Bharat Bhaskar: Electronic Commerce,TataMc-Graw-Hill, New Delhi, 2003
4. E-Commerce — Business, Technology, Society, Kenneth C.Taudon, Carol Guyerico-Traver.

Course Structure

A8682 - Full Stack Development

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The popularity of JavaScript has brought many advancements and changed the face of web development. Real-world applications are looking at the web design with push capabilities. The purpose of this course is to study the concepts of JAVASCRIPT, React JS and Node JS to build user interface web-based applications to meet real-world needs.

Course Pre/co-requisites

A8604 - Web Technologies

2. Course Outcomes (COs)

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

A8682.1 Demonstrate the fundamentals of scripting languages & non - scripting languages and its differences.
A8682.2 Use react concepts to design forms.
A8682.3 Use different node.js modules to connect with database.
A8682.4 Build web application using Node.js.

3. Course Syllabus

Introduction: Introduction to scripting language, motivation , applications; scripting languages vs non-scripting languages; overview of popular scripting languages-JavaScript, Perl, Python; environments - Node.js and react.js, java scripting language constructs.

React JS: JSX and its use case, DOM, Virtual DOM and its working, ES6, Difference between ES5 and ES6, NPM Modules, React Elements, Render Function, Redux ,ReactJS with Redux.

React JS: Components, Class Component, Props, Events, Forms, CSS, Hooks & Context API, Material UI.

Node.JS: Concepts-modules, packages, working with HTTP, streams and file systems,

events, REST API, ExpressJS.

Node.JS: Database connectivity-Mysql, create connection, create database, working with Database operations-create table, insert, select, update, delete, etc.s

4. Books and Materials

Text Books:

1. Learning Node.js A Hands on Guide to Building Web Applications in JavaScript, Marc Wandschneider, Second Edition, Addinson-Wesley.
2. React.js Book: Learning React JavaScript Library From Scratch, Greg Sidelnikov, Learning Curve, 2017.

Reference Books:

1. Beginning Node.js, Basarat Ali Syed, Apress, 2004.
2. The Node Beginner Book: A Comprehensive Node.js Tutorial, Manuel Kiessling, Leanpub, 2011.
3. FullStack React: The Complete Guide to ReactJS and Friends, Anthony Accomazzo, Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, and Tyler McGinnis.
4. Learning React: Functional Web Development with React and Redux, Alex Banks & Eve Porcello, O'Reily.

Course Structure

A8702 – Artificial Intelligence

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This is an undergraduate course to acquire the ability to design intelligent solutions to problems in a variety of domains and business applications such as natural language Processing, text mining, and robotics, reasoning and problem-solving. AI will focus on problem solving, reasoning, planning and gaming. Through learning problem solving skills can be acquired. The course enables to choose data science domain to implement machine learning and deep learning applications.

Course Pre/co-requisites

A8508-Python Programming Laboratory
A8509-Discrete Mathematical Structures

2. Course Outcomes (COs)

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

A8702.1. Apply AI techniques to solve game playing theorem proving and machine learning.
A8702.2. Apply the propositional logic to AI designs .
A8702.3. Learn different playing and reinforcement learning techniques .
A8702.4. Examine the role of searching strategies in AI environment.
A8702.5. Analyse the constraint satisfaction problems for problem solving.

3. Course Syllabus

Introduction: Introduction to AI - Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

Adversarial Search : Games, Optimal decisions in games, The minimax algorithm, Alpha–Beta pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking search for CSPs, Knowledge-Based Agents, The wumpus world.

Propositional Logic: Inference and proofs, Proof by resolution, Horn clauses and definite clauses. First-Order Logic : Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Planning: Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning ,Graphs, Analysis of Planning approaches, Hierarchical Planning.

Reinforcement learning: Introduction, passive Reinforcement learning, active Reinforcement learning, Generalization in reinforcement learning. Robotics: Introduction, Robot Hardware, Robot Perception, planning to move, moving Robotic Software Architectures.

4. Books and Materials

Text Books:

1. Stuart J.Russel, Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education, 2009.

Reference Books:

1. E.Rich and K.Knight, Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2008.
2. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, Pearson Education Private Limited, India, 2001.
3. George F. Luger , Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition, Pearson, 2008.
4. Shivani Goel, Artificial Intelligence, 4th Edition, Pearson Education Private Limited, India, 2009.

Course Structure

A8781- Computer Organization and Architecture

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
2	0	0	30	0	0	3	40	60	100

1. Course Description

Course Overview

This course is designed to understand the concepts and functionalities of computer system among the various components such as registers, control unit and memory units. The course provides in-depth knowledge of internal working, structuring, and implementation of a computer system, the way the system is structured so that all those catalogued tools can be used properly. In addition, this course helps to construct the circuits to the corresponding operations and also discusses the multiprocessing. It is a fundamental course and provides the concepts and terminology required for advanced courses.

Course Pre/co-requisites

A8402 - Digital Electronics

2. Course Outcomes (COs)

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

A8781.1. Identify various functional aspects of computer hardware.
A8781.2. Choose various instructions and addressing modes to execute an instruction.
A8781.3. Make use of integer and floating point algorithms to perform arithmetic operations on data.
A8781.4. Design control unit and memory for a computer system.
A8781.5. Examine the performance of a system using pipelining and multiprocessors.

3. Course Syllabus

Introduction and Micro operations: Computer functional units, Von – Neumann Architecture, Harvard architecture. Register transfer, Bus and memory transfer, arithmetic micro operations, logic micro operations, shift micro operations, arithmetic logic and shift unit. Data Representation – Fixed point and Floating point.

Instructions and Addressing Modes: Computer Instructions, Instruction Cycle, Register reference instructions, Memory reference instructions, Input-output and Interrupt. Stack organization, instruction formats, addressing modes, data transfer and manipulation, Inter-

rupt Handling and types.

Computer Arithmetic: Introduction, Addition, Subtraction and Multiplication algorithms on signed magnitude and two's complement data, Division Algorithms, Floating point arithmetic operations.

Control Unit and Memory Organization: Control memory, address sequencing, micro program example and design of control unit. Memory Hierarchy, Main Memory – RAM and ROM chips, Cache Memory – Introduction, Cache Mapping Techniques.

Pipelining and Multiprocessors: Parallel processing, Arithmetic Pipeline, Instruction pipeline and RISC pipeline. Multiprocessors- characteristics of multiprocessors, Interconnection structures, Interprocessor arbitration.

4. Books and Materials

Text Books:

1. M. Moris Mano., Computer System Architecture,3rd Edition, Pearson Publication, India, 2006.
2. Stallings William., Computer Organization and Architecture,9th Edition, Pearson Education India, 2012.

Reference Books:

1. Carl Hamacher, ZvonksVranesic, SafeaZaky., Computer Organization,5th Edition, McGraw-Hill, New Delhi, India, 2002.

Course Structure

A8851 - Data Science for Engineers

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

Data Science for Engineers course aims to equip engineering students with the essential knowledge and practical skills required to excel in the dynamic field of data science, emphasizing their ability to proficiently query and analyze diverse datasets. Through this course, students will gain a comprehensive understanding of the intricacies involved in handling heterogeneous data, learning how to effectively preprocess and visualize it. By exploring the methodologies and tools employed in data science, students will not only grasp the theoretical foundations but also engage in hands-on applications. Ultimately, upon completing this course, students will emerge with a well-rounded skill set that encompasses data querying and analytics, data preprocessing and visualization, and a solid foundation in data science methodologies and tools. This comprehensive preparation equips them to navigate the complex landscape of data science effectively and contribute meaningfully to data-driven decision-making processes.

Course Pre/co-requisites

A8005- Computer Oriented Statistical Methods
A8514- Database Management Systems
A8804- Data Analytics

2. Course Outcomes (COs)

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

A8851.1 Identify the various requirements for data science process.
A8851.2 Choose an appropriate database required for processing data.
A8851.3 Demonstrate the data science methodology and text mining approaches.
A8851.4 Make use of data science tools to visualize the insights of data.
A8851.5 Apply various data visualization techniques using Tableau over Google Sheets.

3. Course Syllabus

Importance of Data Science: Need for Data Science, what is Data Science? Data Science Process, Business Intelligence and Data Science, Prerequisites for a Data Scientist, Components of Data Science, Tools and Skills needed. Statistics and Probability- Data Types, Variable Types, Statistics, Sampling Techniques and Probability, Information Gain and Entropy, Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Inferential Statistics.

Databases for Data Science: SQL – Tool for Data Science, Basic Statistics with SQL, Data Munging with SQL, Filtering, Joins, and Aggregation, Window Functions and Ordered Data, Preparing Data for Analytics Tool, Advanced NoSQL for Data Science- Why NoSQL, Document Databases for Data Science, Wide-Column Databases for Data Science, Graph Databases for Data Science.

Data Science Methodology: Analytics for Data Science, Examples of Data Analytics, Data Analytics Life Cycle- Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalization. Data Analytics and Text Mining- Text Mining, Major Text Mining Areas, Text Analytics, Major Components of NLP, Stages of NLP, Statistical Processing of Natural Language, Applications of NLP.

Data Science Tools-I: Python Libraries: DataFrame Manipulation with pandas and NumPy, Data Wrangling: Clean, Transform, Merge, Reshape, Exploration Data Analysis with Python, Time Series Data, clustering with Python, Plotting and Visualization, ARCH and GARCH, Dimensionality Reduction.

Data Science Tools-II: Tableau- Introduction to Data Visualization and Tableau, Dimensions and Measures, Cleaning and Structuring Messy Data Descriptive Statistics, Basic Charts, Joins and blends, Filtering data, Row-level calculations, Aggregate-level calculations, Level of detail calculations, Custom Table Calculations, Dashboard Design & Principles, Special Chart Types, Integrate Tableau with Google Sheets.

4. Books and Materials

Text Books:

1. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, Fundamentals of Data Science, 1st Edition,CRC Press, India,2022.
2. Wes McKinney., Python for Data Analysis, 1st Edition,,O'Reilly Publications, 2015.
3. Joshua N. Milligan, Learning Tableau 2019, Packt Publications,2019.

Reference Books:

1. Avrim Blum, John Hopcroft, Ravindran Kannan., Foundations of Data Science, 1st Edition, Cambridge University Press, 2020.
2. Ani Adhikari and John DeNero,Computational and Inferential Thinking: The Foundations of Data Science,GitBook, 2019.

Course Structure

A8081 - Mathematical Programming

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the Linear programming problem, Formulation and Graphical solution of Linear programming problem, Simplex method, Big -M method, Two-phase simplex method, Dual simplex method, Degeneracy in simplex and unbounded solutions, Transportation problem, Assignment model, Replacement models and Sequencing models. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8081.1. Identify LPP and express in mathematical form to solve by graphical or simplex method.
A8081.2. Apply artificial variable techniques to obtain the optimal solution of an LPP.
A8081.3. Interpret various methods under transportation model to get optimal results.
A8081.4. Solve travelling salesmen problem using Hungarian method.
A8081.5. Develop various replacement and sequencing models to arrive at an optimal decision.

3. Course Syllabus

Introduction to Operations Research: Basic definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem, Simplex method.

Artificial Variables Techniques: Big -M method, Two-phase simplex method, Duality in simplex method, Dual simplex method, degeneracy in simplex and unbound solutions.

Transportation problem: Formulation, solution, unbalanced Transportation problem. Finding initial basic feasible solutions, North-West corner rule, lowest cost entry method and Vogel's approximation method. Optimality test- MODI method, degeneracy in transportation, restricted transportation problem, conditional transportation problem.

Assignment Model: Formulation, Hungarian method for optimal solution, solving unbalanced problem, restricted assignment, conditional assignment problems, crew assignment problems, Travelling salesman problem, Transportation problem as assignment problem.

Replacement Models and Sequencing Models: Replacement Models: Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly, individual replacement policy, group replacement policy. Sequencing Models: Solution of Sequencing Problem, Processing n Jobs through two machines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines.

4. Books and Materials

Text Books:

1. Sharma S. D. Operation Research, Tata McGraw Hill, New Delhi, 2009.
2. Panneerselvam R. Operations Research, 2nd Edition, Prentice Hall of India, India, 2008.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. Sharma J. K. Operations Research – Theory and Applications, 5th Edition, Macmillan India Ltd, India, 2007.

Course Structure

A8082 - Transform Calculus

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course provides mathematical knowledge required to analyze problems encountered in engineering. In this course, the students are acquainted with the Series Solutions of Second Order Ordinary Differential Equations, Fourier Series, Fourier Transforms, Z-Transforms and Applications of Transforms to Integral equations. In addition, this course can be applied in many areas of engineering such as computer graphics, cryptography, wireless communication, signal processing, robotics and animation.

Course Pre/co-requisites

A8002 - Ordinary Differential Equations and Vector Calculus.

2. Course Outcomes (COs)

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

A8082.1. Formulate series solutions of ordinary differential equations.
A8082.2. Develop Fourier series for different types of functions.
A8082.3. Apply Fourier Transform to connect the time and frequency domain.
A8082.4. Analyze Z-transform and discrete signals to solve equations.
A8082.5. Apply Laplace transforms to solve integral equations.

3. Course Syllabus

Series Solutions of Second Order Ordinary Differential Equations: Classification of Singularities, Series Solutions to Differential Equations around zero, Frobenius Method around zero.

Fourier Series: Euler's formulae, Dirichlet's conditions, Fourier series for functions having period , Fourier series for even and odd functions, Half range Fourier sine and cosine series.

Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms, Finite Fourier transforms.

Z-Transforms: Definition, Some standard Z-transforms, Damping rule, Shifting rule, Multiplication by n , Initial and final value theorems. Inverse Z-transforms using partial fractions, Convolution theorem, Solution of difference equations by Z - transforms.

Applications of Transforms to Integral equations: Integral equations, Abel's Integral equations, Integral equation of convolution type, Integro differential equations, Applications

of Transforms to Integral equations.

4. Books and Materials

Text Books:

1. Grewal,B.S. Higher Engineering Mathematics, 43rd Edition, Khanna Publications, 2015.
2. Jain, R.K. and Iyengar, S.R.K. Advanced Engineering Mathematics, Narosa Publishing House, 2015.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. Ramana, B.V. Higher Engineering Mathematics, 23rd Reprint,Tata Mc-GrawHill Education Private Limited, New Delhi, 2015.

Course Structure

A8083 - Numerical Techniques

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course offers more advanced topics of mathematics required to analyze the problems in engineering. Topics to be covered in this course include: Solution of algebraic and transcendental equations, system of linear equations, Interpolation, Numerical differentiation and integration, curve fitting, Numerical solutions of ordinary and partial differential equations. The mathematical skills derived from this course provides necessary base to analytical and theoretical concepts occurring in the program.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8083.1	Apply numerical methods to obtain approximate solutions of algebraic and transcendental equations
A8083.2	Make use of interpolation techniques to find approximate values and derivatives of the function at intermediate points
A8083.3	Compute an approximate value of a definite integral using numerical integration
A8083.4.	Construct curve of best fit for the experimental data using method of least squares
A8083.5.	Select an appropriate numerical method to solve ordinary and partial differential equations.

3. Course Syllabus

Solution of Algebraic, Transcendental Equations and System of Linear Equations: Bisection method, Regula-falsi method, Iteration method, Newton - Raphson method. Iterative methods of solution of system of equations: Jacobi's iteration method, Gauss-Seidel iteration method.

Interpolation: Finite differences: Forward, Backward and Central differences, Other difference operators and relations between them, Differences of a polynomial, Missing terms, Newton's interpolation formulae, Interpolation with unequal intervals: Lagrange's interpolation formula.

Numerical Differentiation, Integration and Curve fitting: Numerical differentiation: Derivatives using Newton's interpolation formulae. Numerical integration: Newton-Cote quadrature formula, Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth

rule. Curve Fitting: Method of least squares, Fitting a straight line, Second degree parabola and Non-linear curves of the form $y = ae^{bx}, y = ab^x, y = ax^b$ by the method of least squares

Numerical Solution of Ordinary Differential Equations of First Order: Taylor's series method, Picard's method, Euler's and modified Euler's Method, Runge-Kutta method of fourth order, Predictor and Corrector methods: Milne's method, Adams-Bashforth-Moulton method.

Numerical Solution of Partial Differential Equations: Finite difference approximations to partial derivatives, Elliptic equations: Solution of Laplace equation by Liebmann's iteration process, Parabolic equations: Solution of one dimensional Heat equation by Schmidt explicit method and Crank-Nicolson implicit method.

4. Books and Materials

Text Books:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. M.K. Jain, S.R.K Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, 5rd Edition, New Age International Publishers, New Delhi, 2007.

Reference Books:

1. Grewal, B.S., Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Ramana, B.V. Higher Engineering Mathematics, 23nd Reprint, Tata McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015.
3. T.K.V. Iyengar, B. Krishna Gandhi & Others, Numerical Methods, 2nd Revised Edition, S Chand & Company Ltd, New Delhi, 2013.

Course Structure

A8084 - Entrepreneurship Development

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course aims to provide students with an understanding of the nature of enterprise and entrepreneurship and introduces the role of the entrepreneur, will inculcate the knowledge of government supporting programs like financial assistance by public sector banks. Apart from this, students learn about the women entrepreneurs and success stories of women entrepreneurs, gain the knowledge of project management and profitability appraisal, focus on importance of training the new entrepreneurs as well as existing entrepreneurs.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8084.1 Identify the role, characteristics, qualities and functions of entrepreneur.
A8084.2 Interpret various Institutional supports for setting up a business enterprise.
A8084.3 Illustrate role, importance and functions of women entrepreneur.
A8084.4 Infer the concept of Project Management and steps in Project development.
A8084.5 Indicate training programs and different training institutions to impart training.

3. Course Syllabus

Entrepreneurship: Importance and role of entrepreneurship, Qualities of an entrepreneur, Functions of entrepreneur, Theories of entrepreneurship, Stimulants of entrepreneurship and Barriers to entrepreneurship, Ethics and Social Responsibility, Role of entrepreneur in economic development.

Institutional Support: Role of Government: Role of IDBI, SIDBI, SIDO, NIESBUD, DIC, Entrepreneurship Development Institute, T-Hub (Telangana Hub).

Women Entrepreneurship: Role & Importance, Functions of women entrepreneur, Profile of Indian Women Entrepreneur, Problems of Women Entrepreneurs, Women Entrepreneurship Development in India and in Foreign Countries.

Project Management: Concept of project and classification of project, Project life cycle identification, Project formulation, Project report, Project evaluation- profitability appraisal, social cost benefit analysis, feasibility analysis, financial analysis and project financ-

ing, Project implementation, Project completion.

Entrepreneur Training: Designing appropriate training programmes to inculcate Entrepreneurial Spirit, significance of entrepreneurial training, Feedback and Performance of Trainees, NSIC, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Telangana Academy for Skill and Knowledge (TASK).

4. Books and Materials

Text Books:

1. Robert Hisrich, Michael P. Peter, Dean A. Shepherd (2010), Entrepreneurship, Tata Mc Graw Hill, New Delhi

Reference Books:

1. Bholanath Datta (2009), Entrepreneurship, Excel publications, India.
2. David H Holt (2010), Entrepreneurship, Prentice hall of India, New Delhi, India

Course Structure

A8085 - Logistics and Supply Chain Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

The LSCM deals with effective management, organizing and monitoring of storage and distribution of goods. It imparts knowledge on the various functions of logistics management. It educate on designing of the supply chain network. it gives clarify the significance of establishing global supply chain. Also it will highlight the role of information technology in supply chain. The aim is to manage the entire order cycle in the most efficient way so that it enhances business development and ensures sustainability and customer satisfaction.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8085.1. Understand the cyclical perspective of logistics and supply chain process.
A8085.2. Learn about the distribution, transportation, warehousing related issues and challenges in supply chain.
A8085.3. Appreciate the significance of network design in the supply chain.
A8085.4. Gain knowledge of various models/tools of measuring the Supply Chain Performance.
A8085.5. Appreciate the role of coordination and technology in supply chain management.

3. Course Syllabus

Understanding Supply Chain: Objectives of a Supply Chain, Importance, Stages of Supply Chain, Value Chain Process, Cycle View of Supply Chain Process, Key Issues in SCM, Logistics & SCM, Supply Chain Drivers and Obstacles, Supply Chain Strategies, Strategic Fit, Best Practices in SCM, Obstacles of Streamlined SCM, Green Supply Chain Management, Supply Chain Sustainability – case study.

Logistics: Evolution, Objectives, Components and Functions of Logistics Management, Difference between Logistics and Supply Chain, Distribution related Issues and Challenges. Gaining Competitive Advantage through Logistics Management. TRANSPORTATION: Functions, Costs, and Mode of Transportation Network and Decision, Models, Containerization, Cross Docking, Reverse Logistics. Outsourcing: Nature and Concept, Strategic Decision to Outsourcing, Third-party Logistics (3PL), Fourth-party Logistics (4PL) - case study.

Designing the Supply Chain Network: Designing the Distribution Network ,Role of Distribution, Factors Influencing Distribution, Design Options, e-Business and its Impact, Distribution Networks in Practice, Network Design in the Supply Chain, Role of Network, Factors Affecting the Network Design Decisions ,Modeling for Supply Chain - case study.

Supply Chain Performance: Bullwhip Effect and Reduction, Performance Measurement: Dimension, Tools of Performance Measurement, SCOR Model. Demand Chain Management, Global Supply Chain, Challenges in Establishing Global Supply Chain, Factors that influence Designing Global Supply Chain Network-case study.

Coordination in a Supply Chain: Importance of Coordination, Lack of Supply Chain Coordination and the Bull whip Effect, Obstacles to Coordination, Managerial Levels, Building Partnerships and Trust, Continuous Replenishment and Vendor Managed Inventories, Collaborative Planning, Forecasting and Replenishment. Role of Information Technology in Supply Chain, Supply Chain 4.0.-Case study.

4. Books and Materials

Text Books:

1. David B. Grant, Chee Yew Wong, Sustainable Logistics and Supply Chain Management: Principles and Practices for Sustainable Operations and Management, Kindle Edition
2. Fundamentals ofLogistics Management (The Irwin/Mcgraw-Hill Series in Marketing), Douglas Lambert, James R Stock, LisaM. Ellram, McGrawhill/Irwin, First Edition, 1998.
3. Vinod V. Sople (2009) Logistic Management (2nd Edn.), Pearson Limited.

Reference Books:

1. IMT Ghaziabad, Advanced Supply Chain Management Sage Publications, 2021.
2. Rajat K. Basiya, Integrated Supply Chain Management, Sage Publications, 2020.
3. K Sridhara Bhat, Logistics & Supply Chain Management, HPH,1e,2017.
4. Chopra, Sunil, Meindl, Peter and Kalra, D.V., Supply Chain Management: Strategy, Planning and Operation, Pearson Education,6e,2016.
5. Altekar, Rahul V, Supply Chain Management: Concepts and Cases, PHILearning,1e,2005.
6. Ballou, R.H. Business Logistics Management.Pearson Education,5e, 2014.
7. Coyle, Bardi, Langley, The Management of Business Logistics–A Supply Chain Perspective, Thomson Press,7e,2003.

Course Structure

A8086 - Management Science

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

In this course, students will learn the fundamental concepts and contributions of Management. It also explains Inventory control techniques, Human Resource Practices, Quality control techniques and Project Management which plays a vital role in the organization.

Course Pre/co-requisites

The course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8086.1 Explain and infer the concepts and aspects of management.
A8086.2 Analyze the contributions of management, organizational structures, plant layouts, work study tools for enhancement of productivity in an organization
A8086.3 Apply the project management techniques to decide the optimum time and cost for completion of a project.
A8086.4 Apply statistical quality control & Inventory control techniques to manage and control products and materials.
A8086.5 Use Human resource management techniques for better people management.

3. Course Syllabus

Introduction: Management - Definition, Nature, Importance of management, Functions of Management- Taylor's scientific management theory, Fayol's principles of management, Contribution of Elton mayo, Maslow, Herzberg, Douglas MC Gregor. Basic concepts of Organisation Authority, Responsibility, Delegation of Authority, Span of control, Departmentation and Decentralization - Organisation structures (Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization).

Operations Management: Plant location, Factors influencing location, Principles and types of plant layouts - Methods of production (job, batch and mass production), Work study - Basic procedure involved in method study and Work measurement.

Quality Control and Materials Management: : Statistical quality control - Meaning-Variables and attributes - X chart, R Chart, C Chart, P Chart, (simple Problems) Acceptance sampling, Sampling plans, Deming's contribution to quality. Materials management - objectives, Need for inventory control, Purchase procedure, Store records, EOQ, ABC analysis, Stock levels.

Human Resource Management (HRM): Concepts of HRM, Basic functions of HR manager: Man power planning, Recruitment, Selection, Training and development, Placement, Wage and salary administration, Promotion, Transfers, Separation, performance appraisal, Job evaluation and Merit rating.

Project Management: Early techniques in project management - Network analysis: Programme evaluation and review technique (PERT), Critical path method (CPM), Identifying critical path, Probability of completing project within given time, Project cost analysis, project crashing (simple problems)..

4. Books and Materials

Text Books:

1. Koontz & weihrich - Essentials of management, TMH, 8th edition, 2010
2. O.P. Khana, Industrial engineering and Management, Dhanpat rai publication

Reference Books:

1. Dr.A.R.Aryasri, Management Science, TMH, 4th edition, 2009.
2. Stoner,Freeman, Gilbert, Management, 6th edition Pearson education, New Delhi, 2004
3. L.S.Srinath, PERT & CPM, 3rd edition East-West press pvt. ltd.-New Delhi.

Course Structure

A8087 - Human Resource Management

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course is intended to disseminate the concepts of Human resource management, functions of Human resource management from human resource planning to employee relations aspects that helps in effective functioning of an organization.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8087.1. Identify the functions of Human Resource Management.
A8087.2. Illustrate the process of Recruitment and selection.
A8087.3. Analyse the needs and methods of training.
A8087.4. Appraise the functional relationship with performance compensation and employee welfare.
A8087.5. Examine the significance of employee relations.

3. Course Syllabus

Introduction to HRM: Objectives and Functions of HRM, Challenges of HRM, Line Managers. HR Roles and responsibilities, Workforce and demographic trends, New Approaches to organizing HR, HR Scorecard - Human Resource Information System (HRIS).

Recruitment and Selection: Job Design, Job Analysis, Process and methods of data collection, Job descriptions and Job specification, Job enlargement, Job enrichment and Job rotation. Human Resource Planning, Recruitment, Sources of Recruitment, Recruitment on Diverse Work Force, e-Recruitment and Selection Process, Employee Testing and Selection, Basic Types of Interviews, Errors in Interviews.

Training and Development: Definition, Training vs. Development, Importance of Training and Development, Process of Training, Methods of Training and Management development programmes. PERFORMANCE APPRAISAL: Concepts of Performance Management, Process of Performance Management, Performance Appraisal, Techniques of Performance Appraisal, Errors in Performance Appraisal, Career Management.

Compensation: Objectives of compensation, Factors influencing on compensation, concept of job evaluation and techniques of job evaluation. EMPLOYEE WELFARE: Concept of employee welfare, performance-based pay benefits, provisions of employee's compensation

act and implications of employee welfare on productivity.

Employee Relations: Employee Associations, Grievances: Grievances Handling Procedure, Employee Separation, Downsizing, Work-Life Integration - Hybrid work culture, contemporary developments in HR practices. Stress Management, talent mobility, Prevention of sexual harassment (POSH) at workplace.

4. Books and Materials

Text Books:

1. Gary Dessler, BijuVarkkey, Human Resource Management, 4th edition, Pearson Publication, 2017.
2. P. Subba Rao, Essentials of Human Resource Management, Himalaya Publishing, 6e, 2021.

Reference Books:

1. Biswajeet Pattanayak, Human Resource Management, 6e, PHI Learning Pvt. Ltd, 2020.
2. Mamoria and Mamoria, Personnel Management, Himalaya Publications, 2006

Course Structure

A8088 – Organizational Behavior

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	45	0	3	40	60	100

1. Course Description

Course Overview

The course focuses upon translation of organizational behaviour theory to practices that result in organizational effectiveness, efficiency, and human resource development. The primary goal of this course is to prepare students for advanced leadership roles in modern organization.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8088.1. Analyse the Concepts and models of Orgnizational Behaviour and Contemporary challenges.

A8088.2. Analyse the relevance of planning and decision making process for the development of the organisation.

A8088.3. Identify various organisation design and control technique for better performance of the company.

A8088.4. Examine the relevance of Individual and group behaviour in an organization and the role of Culture and dynamics

A8088.5. Apply the theories of leadership and motivation to lead people to attain the organisation goals.

3. Course Syllabus

Behavioural Concepts: Nature and Concepts of Orgnizational Behaviour, Models of Organizational Behaviour, Relationship with Other Fields, Contemporary challenges. Learning: Nature and Significance of Learning, Process of Learning, Theories of Learning.

Planning and Decision Making: Planning and Goal Setting, Organizational Planning, Vision, Mission and Goals, Types of Plans, Steps in Planning Process, Approaches to Planning, Planning in Dynamic Environment. Decision-making Process, Types of Decisions, Decision Making Styles, Vroom's Participative Decision-making Model.

Organizing and Controlling: Organizational Structure, Principles of Organizing, Authority, Power and Influence, Designing Organizational Structure. Mechanistic and Organic Structures, Contemporary Organizational Design and its Challenges. Controlling: The Control Process, Controlling for Organizational Performance, Types of Control, Financial Controls, Balanced Scorecard, Bench Marking, Contemporary issues in Controlling.

Organizational Behavior: Individual and Group Behavior: Importance of Organizational Behavior, Culture and Dynamics of Diversity, Personality Theories, Perception, Formation of Group Behavior, Classification of Groups, Group Properties, Group Cohesiveness, Building Teams.

Leadership and Motivation: Leadership Traits, Leadership Styles, Leadership Theories, Power and Politics. Motivation: Approaches to Motivation, Maslow's Needs Hierarchy Theory, Two-factor Theory of Motivation, McGregor's Theory, ERG theory, McClelland's Needs Theory, Valance Theory.

4. Books and Materials

Text Books:

1. K. Aswathappa, Organisational Behaviour, Himalaya Publications, 8e, 2021
2. Harold Koontz, Heinz Weihrich, Mark V Cannice, Essentials of Management, Tata McGraw Hill Education, 11e, 2020.
3. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behaviour, Pearson Education, 18e, 2018.

Reference Books:

1. Luthans Fred, "Organizational Behaviour", Tata McGraw Hill.
2. Rao V S P., "Organizational Behaviour", Excel Books.
3. Chandrani Singh, Aditi Ktri, Principles and Practices of Management and Organizational Behaviour, Sage Publications, 1e,2016.
4. Afsaneh Nahavandi, Robert B. Denhardt, Janet V. Denhardt, Maris P. Aristigueta, Organizational Behaviour, Sage Publications, 1e, 2015.

Course Structure

A8089 – Intellectual Property Rights

Hours Per Week		Hours Per Semester		Credits	Assessment Marks		
L	P	L	P	C	CIE	SEE	Total
3	0	45	0	3	40	60	100

1. Course Description

Course Overview

This Course deals with the types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights. It analyzes and evaluates the procedures involved in submission of application for the grant of intellectual property rights. It also deals with the significance of intellectual property of a business enterprise.

Course Pre/co-requisites

This course has no specific prerequisite and co-requisite.

2. Course Outcomes (COs)

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

A8089.1. Identify the different types of intellectual property, agencies and treaties that protect intellectual property rights
A8089.2. Classify the protectable matter of intellectual property rights.
A8089.3. Analyze and evaluate the procedures involved in submission of application for the grant of intellectual property rights
A8089.4. Interprete Trade secret law, liability for misappropriations of trade secrets, protection for submission, and trade secret litigation

3. Course Syllabus

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Trade Marks: Purpose and function of trademarks, Trade mark rights, protectable matter, selecting and evaluating trademarks, trade mark registration process.

Law of Copy Rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of Patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Trade Secrets: Trade secret law, determination of trade secrets status, liability for misappropriations of trade secrets, protection for submission, and trade secret litigation.Unfair Competition: Misappropriation right of publicity, false advertising.

4. Books and Materials

Text Books:

1. R.S.Nagarajan, a Textbook on Professional Ethics and Human Values, New Age Publishers – 2006. Deborah.
2. Neeraj Pandey, Khushdeep Dharni- 2014, Intellectual property rights, PHI, India.

Reference Books:

1. Prabudda ganguli (2003), Intellectual property right, Tata McGraw Hill Publishing company ltd., India.
2. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew, Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA, 1985
3. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010

Course Structure

A8090 - Professional Practice, Law and Ethics

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

This course makes students to understand the types of roles they are expected to play in the society as practitioners of an engineering profession. It develops ideas of the legal and practical aspects of their profession. Students will learn importance of professional practice, Law and Ethics in their personal lives and professional careers and the rights and responsibilities as an employee and team leader.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8090.1. Apply the concepts of professional practice, Law and Ethics in their personal lives and professional careers.
A8090.2. Analyze Arbitration, Conciliation and Alternative Dispute Resolution system
A8090.3. Interpret Law relating to Intellectual property
A8090.4. Apply the rights and responsibilities as an employee, team member in any organization as a global citizen.

3. Course Syllabus

Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stake holders.

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996;UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention;

International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

Engagement of Labour and Labour & other construction-related Laws: Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other - Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970.

4. Books and Materials

Text Books:

1. R. Subramanian - Professional Ethics, Oxford University Press, 2015.
2. Ravinder Kaur - Legal Aspects of Business, 4th edition, Cengage Learning, 2016.

Reference Books:

1. RERA Act, 2017.
2. Wadhera - Intellectual Property Rights, Universal Law Publishing Co.,2004.
3. 3. T. Ramappa - Intellectual Property Rights Law in India, Asia Law House,2010.
4. 4. O.P. Malhotra - Law of Industrial Disputes, N.M. Tripathi Publishers.

Course Structure

A8091 - National Cadet Corps(NCC)

Hours Per Week			Hours Per Semester			Credits	Assessment Marks		
L	T	P	L	T	P	C	CIE	SEE	Total
3	0	0	45	0	0	3	40	60	100

1. Course Description

Course Overview

National Cadet Corps, is a unique course designed for youth in India that aims to develop character, discipline, leadership, secular outlook, spirit of adventure, and ideals of selfless service among young citizens. Through this course students learn about rhe national integration and its importance. They understand the concept of self-awareness and emotional intelligence, critical & creative thinking, decision making & problem solving and importance of Social service.This course also explores the security challenges & role of cadets in border areas. Students acquire the knowledge about various wars and their heroes.

Course Pre/co-requisites

This course has no specific prerequisite and co requisite.

2. Course Outcomes (COs)

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

A8091.1. Acquire knowledge of the history of NCC, its organization, and incentives of NCC for their career prospects and duties & conduct of ncc cadets.

A8091.2. Imbibe good leadership traits and apply them in practical life and appreciate the visible outcome of leadership and motivation.

A8091.3. Develop a sense of responsibility, smartness in appearance and improve self-confidence, inculcate importance of empathizing with others, improve their deep-thinking ability and apply ideas and be able to face problems in a constructive manner with solutions.

A8091.4. Learn about the various natural resources, their utilization and practice method of conservation of these resources in daily life.

A8091.5. Appreciate value of physical and mental health in daily life and spread awareness about treatment and care of wounds in their society.

A8091.6. Understand individaul responsibilities & role in meetings the security challenges on Border/Coastal areas.

3. Course Syllabus

Introduction to NCC and National Integration: Introduction of NCC, History, Aims, Objective of NCC & NCC as Organization, Duties of NCC Cadet. National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building.

Personality Development & Leadership: Intra & Interpersonal skills - Self-Awareness- & Analysis, Empathy, Critical & creative thinking, Decision making and problem solv-

ing. levels of Creativity, Characteristics of creative person. Leadership capsule., Important Leadership traits, Indicators of leadership and evaluation., Motivation- Meaning & concept, Types of motivation. Factors affecting motivation., Ethics and Honor codes.

Social Service & Community Development: Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of Children & Women Safety., Road/Rail Safety., New Government Initiatives., Cyber and mobile Security Awareness.

Environmental Awareness and Conservation: Natural Resources, Conservation and Management, Water Conservation, Waste Management, Energy Conservation. Adventure Environmental Awareness and Conservation. Health & Hygiene: Hygiene & Sanitation (Hygiene- Personal & Social Hygiene)., First Aid in common medical emergencies. Treatment & Care of Wounds.

Border & Coastal Areas: History, Geography & Topography of Border/ Coastal Areas. Security Setup and Border/Coastal management in the area., Security Challenges & Role of cadets in Border management.

4. Books and Materials

Text Books:

1. R. K. Gupta, "Hand book of NCC Cadets for A, B & C Certificate Examinations", R-1992, 23rd Edition. Ramesh Publishing House, New Delhi (2023).