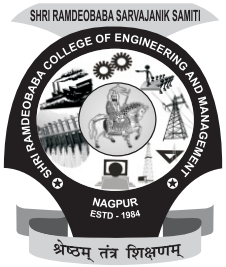

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2021 – 2022

B. Tech. (ELECTRONICS ENGINEERING)

Published By

Dr. R. S. Pande

Principal
Shri Ramdeobaba College of Engineering & Management
Ph. : 0712-2580011 Fax : 0712 - 2583237
ISO 9001 : 2015 CERTIFIED ORGANISATION

About the Department

The department of Electronics Engineering was established in 1986 and offers an undergraduate (UG) programme in Electronics Engineering and a postgraduate (PG) programme in M. Tech. (VLSI Design). The National Board of Accreditation; New Delhi has accredited the UG programme five times in succession in the year 2003, 2007, 2013, 2017&2020 and PG programme in 2016. It is a recognized center for higher learning and research of RTM Nagpur University. The department admits research scholars under Visvesvaraya Ph.D Scheme of Meity, Govt. of India and National Doctoral Fellowship Scheme of AICTE.

The undergraduate curriculum follows a CBCS promoting interdisciplinary learning. The curriculum also provides an opportunity for students to earn extra credits through Honors and Minor Certification in area of IOT, AI for Edge Computing and Industry 4.0. The students undergo projects and six-month internship at various industries, institutes of repute and RCOEM-TBI.

The department has 16 state of the art laboratories with investment of over Rs. 2 crores. The state-of-the-art laboratories include major software for VLSI design, COMSOL Multiphysics software, development and verification platforms such as Mentor Graphics FPGA Advantage, Agilent ADS Design Suit, Tanner Tool, Keil MDK, Virtex 5 Development platform and Embedded System Design environments. Storage Oscilloscope, MIC Trainer, Digital Signal Processors, Pattern Generator and logic analyzer, VNA, MATLAB, Lab View are also a part of the state-of-the-art labs.

The Department consistently organizes workshops, training programs and guest lectures for students / researchers for up-gradation of their technical skills. The department also organizes partial delivery of courses by industry experts with the objective of understanding the industrial application of the core subjects and industry practices. There are various technical clubs, formed at the departmental level, in which, the students actively participate for various national and international events. Campus recruitment training programs are also organized to train and prepare the students for placement drives.

Department Vision

Electronics Engineering Department endeavors to facilitate state of the art technical education in the field of electronics engineering by infusing scientific temper in students leading towards research and to grow as Centre of excellence in the field of microelectronics.

Department Mission

1. To promote quality education through stimulating environment for dissemination of knowledge and technology.
2. To impart necessary technical, professional skills with moral and ethical values to enable students for achieving a successful career.
3. To develop centre of excellence in the field of microelectronics and its allied areas with continuing education program.
4. To foster research and development in collaboration with institutions/industries.

Program Educational Objectives (PEO'S) Program Objectives

1. To prepare graduates to solve engineering problems exhibiting a strong foundation in mathematics, science and electronics engineering fundamentals.
2. To inculcate an ability to design and develop electronic systems to cater the needs of the society and give exposure to emerging edge technologies.
3. To instill sense of professional and ethical values, effective communication, teamwork, multidisciplinary approach and lifelong learning to excel in professional career / higher studies.

Program Outcomes

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.

Programme Specific Outcomes

PSO1. An ability to apply concepts of electronics engineering and computing technologies to analyze complex systems in the areas of signal processing, embedded systems and VLSI.

PSO2. An ability to comprehend the technological advancements in the usage of modern design tools to design systems for diverse applications.

Teaching Scheme for First Year (Semester I & II) Bachelor of Engineering
Group 1 : Semester - I / Group 2 : Semester - II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	PHT156	Semiconductor Physics	3	1	0	4	40	60	100	03
2.	PHP156	Semiconductor Physics Lab	0	0	3	1.5	25	25	50	–
3.	MAT152/ MAT151	Differential Equations, Linear Algebra, Statistics & Probability / Calculus	3	0/1	0	3/4	40	60	100	03
4.	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	–
5.	EET151	Basic Electrical Engineering	3	1	0	4	40	60	100	03
6.	EEP151	Basic Electrical Engineering Lab	0	0	2	1	25	25	50	–
7.	MET151	Engineering Graphics & Design	1	0	0	1	40	60	100	03
8.	MEP151	Engineering Graphics & Design Lab	0	0	4	2	50	50	100	–
9.	HUT152	Constituation of India	2	0	0	0	–	–	–	–
10.	PEP151	Yoga / Sports	0	0	2	0	–	–	–	–
		TOTAL	**12**	**2/3**	**13**	**17.5/18.5**			**650**	

Group 2 : Semester - 1 / Group 1 : Semester - II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	CHT151	Chemistry	3	1	0	4	40	60	100	03
2.	CHP151	Chemistry Lab	0	0	3	1.5	25	25	50	–
3.	MAT151/ MAT152	Calculus/Differencial Equations, Linear Algebra, Statistics & Probability	3	1/0	0	4/3	40	60	100	03
4.	CST151	Programming for Problem Solving	4	0	0	4	40	60	100	03
5.	CSP151	Programming for Problem Solving Lab	0	0	2	1	25	25	50	–
6.	IDT151	Creativity, Innovation & Design Thinking	1	0	0	1	20	30	50	1.5
7.	INT151	Workshop/Manufacturing Practices	1	0	0	1	20	30	50	1.5
8.	INP151	Workshop/Manufacturing Practices Lab	0	0	2	1	25	25	50	–
9.	HUT151	English	2	0	0	2	40	60	100	03
10.	HUP151	English Lab	0	0	2	1	25	25	50	–
		TOTAL	**14**	**2/1**	**9**	**20.5/19.5**			**700**	

Scheme of Teaching & Examination of Bachelor of Engineering
(Electronics Engineering)
Semester III

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	MAT254	Complex Variables and Partial Differential Equation	2	0	0	2	40	60	100	3hrs
2.	EET261	Network Theory	3	0	0	3	40	60	100	3Hrs
3.	ENT251	Electronic Devices and Circuits	3	1	0	4	40	60	100	3Hrs
4.	ENP251	Electronic Devices and Circuits Lab	0	0	2	1	25	25	50	
5.	ENT252	Digital Circuit Design	3	0	0	3	40	60	100	3Hrs
6.	ENP252	Digital Circuit Design Lab	0	0	2	1	25	25	50	
7.	ENT253	Signals and Systems	3	1	0	4	40	60	100	3Hrs
8.	CST261	Data Structures and Algorithms	2	0	0	2	40	60	100	3Hrs
9.	CSP261	Data Structures and Algorithms Lab	0	0	2	1	25	25	50	
10.	CHT251	Environmental Studies	2	0	0	0	–	–	–	
		TOTAL	**18**	**2**	**6**	**21**				

Semester IV

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	ENT254	Digital Signal Processing	3	0	0	3	40	60	100	3Hrs
2.	ENP254	Digital Signal Processing Lab	0	0	2	1	25	25	50	
3.	ENT255	Analog Circuits	3	1	0	4	40	60	100	3Hrs
4.	ENP255	Analog Circuits Lab	0	0	2	1	25	25	50	
5.	ENT256	Microprocessor and Microcontroller	3	0	0	3	40	60	100	3Hrs
6.	ENP256	Microprocessor and Microcontroller Lab	0	0	2	1	25	25	50	
7.	ENT257	Electromagnetic Fields	3	0	0	3	40	60	100	3Hrs
8.		Open Elective 1 / MOOC	3	0	0	3	40	60	100	3Hrs
9.	IDT254	Biological Science	3	0	0	3	40	60	100	3Hrs
		TOTAL	**18**	**1**	**6**	**22**				

Semester V

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	EET361	Control Systems	3	0	0	3	40	60	100	3Hrs
2.	ENT351	Electromagnetic Waves	3	0	0	3	40	60	100	3Hrs
3.	ENT352	CMOS Digital Circuit Design	3	1	0	4	40	60	100	3Hrs
4.	ENP352	CMOS Digital Circuit Design Lab	0	0	2	1	25	25	50	
5.	ENT353	Electronic Instrumentation	3	0	0	3	40	60	100	3Hrs
6.	ENP354	Instrumentation and control Lab	0	0	2	1	25	25	50	
7.	ENT355	Program Elective – 1	3	0	0	3	40	60	100	3Hrs
8.	ENP355	Program Elective – 1 Lab	0	0	2	1	25	25	50	
9.		Open Elective 2 / MOOC	3	0	0	3	40	60	100	3Hrs
10.	HUT351	Professional Skill Development	2	0	0	0	–	–	–	–
		TOTAL	**20**	**1**	**6**	**22**				

Program Elective - I (V Semester)	
ENT 355-1 / ENP 355-1	Embedded System Design and RTOS
ENT 355-2 / ENP 355-2	Mechatronics
ENT 355-3 / ENP 355-3	Digital Image Processing
ENT 355-4 / ENP 355-4	Object Oriented Programming using Python

Semester VI

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	MBT351	Business Management and Entrepreneurship	3	0	0	3	40	60	100	3Hrs
2.	ENT357	Analog and Digital Communication	3	1	0	4	40	60	100	3Hrs
3.	ENP357	Analog and Digital Communication Lab	0	0	2	1	25	25	50	
4.	ENT358	Probability Theory and Stochastic Processes	3	0	0	3	40	60	100	3Hrs
5.	ENP359	Electronic Design Workshop	0	0	2	1	25	25	50	
6.	ENT360	Computer Architecture and Organization	3	0	0	3	40	60	100	3Hrs
7.	ENP360	Computer Architecture and Organization Lab	0	0	2	1	25	25	50	
8.	ENT361	Program Elective – 2	3	0	0	3	40	60	100	3Hrs
9.	ENP361	Program Elective – 2 Lab	0	0	2	1	25	25	50	
10.		Open Elective 3 / MOOC	3	0	0	3	40	60	100	3Hrs
11.	ENP363	Comprehensive Viva	0	0	2	1	25	25	50	
		TOTAL	**18**	**1**	**10**	**24**				

Program Elective - 2 (VI Semester)	
ENT 361-1 / ENP 361-1	Designing the IoT
ENT 361-2 / ENP 361-2	Microwave Theory and Techniques
ENT 361-3 / ENP 361-3	Machine Learning
ENT 361-4 / ENP 361-4	Database Management System

Semester VII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	ENT451	Computer Networks	3	0	0	3	40	60	100	3Hrs
2.	ENP451	Computer Networks Lab	0	0	2	1	25	25	50	
3.	ENT452	Program Elective -3	3	0	0	3	40	60	100	3Hrs
4.	ENT453	Program Elective -4	3	0	0	3	40	60	100	3Hrs
5.		Open Elective 4 / MOOC	3	0	0	3	40	60	100	3Hrs
6.	ENP455	Project Stage-I	0	0	10	5	100		100	
7.	ENP456	Industry internship evaluation(6-8 weeks)	0	0	2	0	50		50	
		TOTAL	12	0	14	18				

Program Elective - 3 (VII Semester)		Program Elective - 4 (VII Semester)	
ENT 452-1	Digital System Design	ENT 453-1	Testing and Verification of Digital Systems
ENT 452-2	Wireless C ommunication	ENT 453-2	Fiber Optics Communication
ENT 452-3	Analog IC Design	ENT 453-3	Micro-Electro Mechanical System

Semester VIII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
			L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	ENT457	Program Elective - 5	3	0	0	3	40	60	100	3Hrs
2.	ENT458	Program Elective - 6	3	0	0	3	40	60	100	3Hrs
3.	ENP459	Project Stage - II	0	0	18	9	50	50	100	
		TOTAL	**6**	**0**	**18**	**15**				
		OR								
4.	ENP460	Internship / Incubation (Six months)				**15**	**100**	**100**	**200**	

Program Elective - 5 (VIII Semester)		Program Elective - 6 (VIII Semester)	
ENT457-1	CMOS Subsystem Design	ENT458-1	Nano Electronics
ENT457-2	Information Theory and Coding	ENT458-2	SoC Design
ENT457-3	Biomedical Signal Processing	ENT458-3	Power Electronics

Open Elective Pool - 1 (V/VIII Semester)		Open Elective Pool - 2 (V/VI Semester)	
ENT398-1/ENT498-1	Smart Agriculture	ENT299-1/ENT399-1	Industrial Automation
ENT398-2/ENT498-2	Arduino Playground	ENT299-2/ENT399-2	Micro Nano system
ENT398-3/ENT498-3	Consumer Electronics	ENT299-3/ENT399-3	Designing with Raspberry Pi
ENT398-4/ENT498-4	Drone Technology		

Scheme of Teaching & Examination of Honors/ Minor Specialization in Electronics Engineering

Honors in AI for Edge Computing/ IoT

Sr. No.	Semester	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	IV	ENTH42	*Introduction to Artificial Intelligence and Machine Learning	4	0	0	4	40	60	100	3Hrs
		ENTH43	# Introduction to IoT								
2.	V	ENTH52	*Deep Learning for Visual Recognition	4	0	0	4	40	60	100	3Hrs
		ENTH53	# Sensor Interfacing with Arduino and ESP8266								
3.	VI	ENTH62	*Edge for AI Fundamentals	4	0	0	4	40	60	100	3Hrs
		ENTH63	# Cloud Computing using Raspberry pi								
4.	VII	ENTH72	*Hardware Designing for AI/ML Applications	4	0	0	4	40	60	100	3Hrs
		ENTH73	# Data Management and Analytics for IoT								
5.	VIII	ENTH81	Project	0	0	4	4	50	50	100	3Hrs
							20				

* If students want to pursue Honors in Electronics with specialization AI for edge computing # If students want to pursue Honors in Electronics with specialization in IoT

Note : Credit transfer against above courses may be allowed if an appropriate MOOC course is completed by student after prior permission from HOD

Minor in Industry 4.0

Sr. No.	Semester	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)
				L	T	P		Continuous Evaluation	End Sem Exam	Total	
1.	IV	ENTM42	Sensors and Actuators for CPS	4	0	0	4	40	60	100	3Hrs
2.	V	ENTM52	Factory Automation	4	0	0	4	40	60	100	3Hrs
3.	VI	ENTM62	Industrial IoT network	4	0	0	4	40	60	100	3Hrs
4.	VII	ENTM72	Technologies of Smart Factory	4	0	0	4	40	60	100	3Hrs
5.	VIII	ENTM82	Mini Project	0	0	4	4	50	50	100	3Hrs
			TOTAL				**20**				

Note : If any of the above course is accessible to a student in his/her parent branch or Open electives then Credit transfer against above courses may be allowed if an appropriate MOOC course is completed by student after prior permission from HOD.

Syllabus for Semester I / II

Course Code : PHT156 **Category : Basic Science Course**

Course : PHYSICS : Semiconductor Physics (Theory)

L: 3 Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits : 4**

Course Objective

1. To introduce ideas of quantum mechanics necessary to begin understanding semiconductor devices;
2. To familiarize prospective engineers with fundamental concepts of semiconductors and their interaction with light and resulting devices

Course Outcomes

After successful completion of the course students will

1. have an elementary understanding of quantum behaviour of electrons in solids;
2. have a grasp of band structure and its consequences for semiconductors;
3. should be able to use band structure to explain effects of doping,on the properties of junctions between semiconductors and metals;
4. have an elementary understanding of working of optoelectronic devices

Module 1: Quantum Mechanics Introduction

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

Module 2: Electronic Materials

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

Module 3: Intrinsic and Extrinsic Semiconductors

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier transport: diffusion and drift

Module 4: Non-Equilibrium Semiconductors

Carrier generation and recombination, Continuity equation, Ambipolar transport equation, Quasi-Fermi Energy levels, Excess Carrier Lifetime, Qualitative introduction to recombination mechanisms, Shorkley-Read-Hall Recombination, Surface Recombination

Module 5: Junction Physics

p-n junction, Zero applied bias, forward bias, reverse bias, Metal-semiconductor junction, Shottky barrier, Ideal junction properties, Ohmic contacts, ideal non-rectifying barrier, tunneling barrier, Heterojunctions, Nanostructures, Energy band diagram, two dimensional electron gas

Module 6: Light - Semiconductors Interaction

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

Text Book(s)

Modules 1-5

1. Semiconductor Physics and Devices (Fourth Edition), Donald A. Neamen, McGraw-Hill 2012.

Reference

1. Physics of Semiconductor Devices, S. M. Sze, 2nd Edition, Willey-Interscience Publication 1986

Modules 6

1. Online course: Semiconductor Optoelectronics by M. R. Shenoy on NPTEL
2. Optoelectronics and Photonics: Principles and Practices by S. O. Kasap, Prentice Hall 2001

Syllabus for Semester I / II

Course Code : PHP156 **Category : Basic Science Course**

Course : Semiconductor Physics (Lab)

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits : 1.5**

Course Outcomes

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

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the General physics experiments, the Lab turns will be utilized for performing the experiments based on the following lists as specific to Program

General Physics

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

Semiconductor Physics and Devices

1. Energy gap of semiconductor/thermister
2. Study of Hall Effect
3. Parameter extraction from I-V characteristics of a PN junction diode
4. Parameter extraction from I-V characteristics of a zener diode

5. Study of diode rectification
6. Parameter extraction from I-V characteristics of a transistor in common-emitter configuration.
7. V-I Characteristics of Light Emitting Diodes
8. Study of a photodiode
9. Solar Cell (Photovoltaic cell)
10. Resistivity measurement by Four Probe method

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

Syllabus for B.E. Semester I / II

Course Code : MAT151 **Course : Calculus**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 04**

Course Objective

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

Course Outcomes

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

1. The fallouts of Mean Valve Theorems that is fundamental to application of analysis to Engineering problems , to deal with functions of several variables that are essential in most branches of engineering.
2. Basics of improper integrals, Beta and Gamma functions, Curve Tracing , tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. Multivariable Integral Calculus and Vector Calculus and their applications to Engineering problems.

Syllabus

Module 1: Calculus: (7 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's series expansions; Indeterminate forms and L'Hospital's rule; radius of curvature (Cartesian form), evolutes and involutes

Module 2:Multivariable Calculus (Differentiation) (8 hours)

Limit, continuity and partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 3 Calculus: (6 hours)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Tracing of curves(Cartesian form)

Module 4:Sequences and series: (7 hours)

Convergence of sequence and series, tests for convergence, power series, Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 5: Multivariable Calculus (Integration) (7 hours)

Multiple Integration: Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by double integration Center of mass and Gravity (constant and variable densities).

Module 6 : Vector Calculus (7 hours)

Vector Differentiation, Directional derivatives, total derivative, Gradient, Curl and Divergence. Vector integration , Theorems of Green, Gauss and Stokes.

Topics for self learning

Maxima and minima for function of one variable, Geometrical interpretation of Partial Differentiation(Tangent plane and Normal line) , Applications of definite integrals to evaluate perimeter, area, surface areas and volumes of revolutions.

Textbooks / References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).

Syllabus for B.E. Semester I / II

Course No. MAT152 **Course : Differential Equations, Linear Algebra, Statistics & Probability**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Ordinary differential equation, statistics, probability and Matrices.

It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Outcomes

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

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

Syllabus

Module 1:First order ordinary differential equations(7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree : equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3:Basic Statistics: (7 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, correlation and regression – Rank correlation, Multiple regression and correlation.

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Topics for Self Learning

Application of Differential Equations.

Textbooks / References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory and Problems of probability and statistics : 2nded :J. R. Spiegal ,Schaum series
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

Syllabus of Mathematics Computational Lab for Semester I/II, B.E.

Course Code : MAP151 **Course : Computational Mathematics Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 1**

Course Outcomes

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

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

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

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

Suggested References

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

A minimum of 8 experiments to be performed based on the above list.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EET151 Course : Basic Electrical Engineering

Course Outcomes

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

CO1: Understand and analyze basic ac and dc electric circuits and magnetic circuits

CO2: Understand working principles of electrical machines: Transformer, Induction motor, DC machines

CO3: Apply the knowledge of power converter for suitable applications

CO4: Introduce and identify the components of power systems and low-voltage electrical Installations.

Module 1: Introduction to Power system (2 hours)– CO4:

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind, and Solar) with block schematic presentation only. Single line diagram for Generation, Transmission & Distribution through different voltage levels.

Module 2 : DC Circuits & Magnetic Circuits(8 hours) - CO1:

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation, Time-domain analysis of first order RL and RC circuits, Magnetic materials, BH characteristics, Basics of Magnetic circuits.

Module 3: Single Phase AC Circuits (6 hours) - CO1:

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.

Module 4: Three Phase AC Circuits (4 hours) - CO1:

Three phase Ac generation, Three phase balanced circuits, voltage, and current relations in star and delta connections. Power factor improvement.

Module 5: Transformers (6 hours) - CO2:

Ideal and practical transformer, Equivalent circuit, losses in transformers, regulation, and efficiency. Auto transformer and three-phase transformer connections.

Module 6: Electrical Machines (8 hours) - CO2:

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components, efficiency, starting of induction motor. Single- phase induction motor. Construction, working, torque-speed characteristic, and speed control of separately excited dc motor.

Module 7: Power Converters (4 hours) - CO3:

Block schematic introduction to power converters and its practical applications (DC-DC, DC-AC, AC-DC, AC- AC), Types of Batteries, Important Characteristics for Batteries and battery backup.

Module 8: Electrical Installations (4 hours) - CO4:

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption, energy tariff.

Text Books / References

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
6. Electrical Technology: B. L. Thereja, S. Chand Publications.
7. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Syllabus of Group 1 - Semester I and Group 2 - Semester II

Course Code : EEP151 **Course: Basic Electrical Engineering Lab.**

Course Outcomes

Upon completion of this course, the students shall be able to,

CO1: Co-relate, analyze and apply the fundamental principles of science and engineering to understand the laboratory experimental work.

CO2: Connect the electric circuit, perform the experiment, analyze the observed data and make valid conclusion.

CO3: Write report based on the performed experiments (journal) with effective presentation of diagrams and characteristics/graphs.

CO4: Carry out survey of electrical energy consumption at home and calculate monthly energy bill as per the tariff of power Distribution Company.

List of Experiments

1. To verify Kirchhoff's laws for D.C. Circuits
2. Verification of Kirchhoff's laws to AC circuit(RLC series)
3. Verification of Kirchhoff's laws to AC circuit (RLC parallel).
4. To study speed control of D.C. shunts motor by:
   a) Armature voltage Control method.
   b) Field current/flux control method.
5. To study the balanced Three phase system for star and delta connected balanced load.
6. Improvement of power factor by using static capacitors
7. To determine regulation and efficiency of a single phase transformer by open circuit (o.c) and short circuit (s.c.) tests.
8. To determine regulation and efficiency of a single phase transformer by direct loading test

Demonstration/ Study experiment

9. To study B-H curve for different magnetic material
10. To study Buck converter
11. To study Boost converter

Demonstration of cut out sections of machines:

i. DC Machine
ii. Three phase squirrel cage induction motor
iii. Synchronous machine

Syllabus of Department of Mechanical Engineering

Course Code : MET151 **Course: Engineering Graphics and Design**

L:1 Hr., T:0Hrs., P:0 Hrs., Per week **Total Credits : 01**

Course Outcomes

The expected learning outcome is that, the students shall be able to

1. Draw and interpret technical drawing
2. Convert 2-D to 3-D drawing and vice versa.
3. Represent the various positions of planes and solids in different orientations.
4 Develop the solid surface for sheet metal working.

UNIT 1 : Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of drawing instruments, Lettering and dimensioning.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions : Projections of Points and lines (line inclined to both planes) Projections of planes (inclined to both the planes), Introduction to Auxiliary Planes;

UNIT 3 : Projections of Solids

Inclined to both the Planes - Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include : windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UNIT 4 : Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid Cone-Auxiliary Views; Development of surface of Right Regular solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT 5 : Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; Conversion of Orthographic views to Isometric Views / Projection.

Suggested Text / Reference Books

i) Bhatt N. D. Panchal V.M. & Ingle P.R., (2014) Engineering Drawing, Charotar Publishing House.

ii) Jolhe D. A. (2016) Engineering Drawing with an Introduction to Auto CAD", Tata McGraw- Hill Publishing Co. Ltd., New Delhi.

iii) Narayan K. L. & P. Kannalah (2008), Text book on Engineering Drawing, Scitech Publishers.

iv) Shah, M. B. & Rana B. C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.

v) Agrawal B & Agrawal C. M. (2012), Engineering Graphic, TMH Publication.

vi) Corresponding set of CAD Software Theory and User Manuals.

Syllabus of Department of Mechanical Engineering

Course Code : MEP151 **Course : Engineering Graphics & Design Lab**

L:0 Hr., T:0Hrs., P:4 Hrs., Per week **Total Credits : 02**

Course Outcomes

Students are prepared for actual work situations through practical training in a new state of the art computer designed CAD laboratory using engineering software. The student will learn to :

1. Draw and interpret technical drawing
2. Plan the sheet layout for the given drawing
3. Convert 2-D to 3-D drawing and vice versa
4. Represent the various positions of planes and solids in different orientations.
5. Develop the solid surface for sheet metal working
6. Use & demonstrate drafting package.

UNIT 1 : Introduction to Engineering Drawing

Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and involutes; Introduction to Scales.

UNIT 2 : Orthographic Projections

Principles of Orthographic Projections -Conventions - Projections of Points and lines inclined to both planes; Projections of planes - Auxiliary Planes.

UNIT 3 : Projections of Solids

Inclined to both the Planes Auxiliary Views; Draw simple annotation, dimensioning and scale, Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, e t c .

UNIT 4 : Sections and Sectional Views of Right Angular Solids

Prism Cylinder, Pyramid, Cone - Auxilary Views; Development of surfaces of Right Regular Solids Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT 5 : Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; conversion of Orthographic views to Isometric views / Projection

UNIT 6 : Overview of Computer Graphics

Demonstrating knowledge of the theory of CAD software such as (the Menu System Toolbars Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, crosshairs, Coordinate Systems), Dialog boxes and windows, Shortcut menus (Button Bars), The command Line (wherever applicable), The Status Bar, Different methods of zoom as used in CAD, select and erase objects; Isometric Views of lines, Planes, Simple and compound solids);

UNIT 7 : Customization & CAD Drawing

Setting up drawing page and the printer, including scale settings, Setting up of units and Drawing limits; ISO and ANSI standards for coordinate dimensioning; Orthographic constraints, map to objects, manually and automatically, Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT 8 : Annotations Layering & Other Functions

Applying dimensions to objects, applying annotations to drawings; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques.

UNIT 9 : Demonstration of a simple team design project that illustrates

Geometry and Topology of Engineered Components Creation of Engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed toplogies for engineering, Introduction to Building Information Modeling (BIM), Drafting and design package, 3D printing.

List of sheets

1. Curves (ellipse, Parabola, hyperbola, Cycloid, involute)
2. Line, Planes, Solids
3. Application of Section and development of solids
4. Orthgraphic Projection
5. Isometric
6. Auto CAD practice sheet 1
7. Auto CAD practice sheet 2
8. Blueprint sheet

Suggested Text/ Reference Books

i) Bhatt N.D. Panchal V.M. & Ingle P.R., (2014), Engineering drawing, Charotar Publiishing house

ii) Jolhe D.A., (2016) Engineering drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

iii) Shah M.B. & Rana B.C. (2008), Engineering drawing and Computer Graphic, Pearson Education.

iv) Agarwal B & Agarwal C.M. (2012), Engineering Graphics, TMH PUBLICATION

v) Narayana, K.L & P Kannaiah (2008), Text Book on Engineering Drawing, Scitech Publishers.

vi) (Concesponding set of) CAD Software Theory and USER Manuals.

Syllabus for B.E. Semester I Department of Humanities

Course Code : HUT152 **Course : Constitution of India**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 0**

Course Outcome

1. Students will understand the role of constitution in democratic India
2. Students will be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course Content

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

Text Book

Durga Das Basu "An Introduction to Constitution of India" 22nd Edition, Lexis Nexis

Syllabus for B.E. Semester I Department of Physical Education

Course Code : PEP151 **Course : Yoga / Sports**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits : 0**

Course outcome

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

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

Brief Objectives of Sports/Yoga Practical Classes:

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

- **Sports**

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

- **Yoga :** Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.
- **Physical Efficiency Tests :** This includes 6 health related physical fitness tests.

Components	Name of Tests
Speed	50 mts Dash
Agility	Shuttle run
Cardiovascular Endurance	8 mins Run/Walk
Test Flexibility	Sit and Reach Test
Abdominal Strength (M) / shoulder strength (F)	Bent Knee Sit-ups (M)/ Modified Pull-ups (F)
Yogic exercises	Suryanamaskars

Syllabus for B.E. Semester I / II

Course Code : CHT151 **Course : Chemistry**

L: 3 Hrs, T: 1 Hr, P : 0 Hr., Per week **Total Credits : 4**

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10 + 2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand different phenomena; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Rationalise periodic properties such as ionization potential, electro-negativity, oxidation states and electron affinity.
- Analyse microscopic chemistry in terms of atomic and molecular orbitals and to apply this knowledge for understanding the band structure of different types of solids.
- Understand different types of molecular interactions, rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- List major chemical reactions that are used in the synthesis of molecules and to understand structural aspect of organic compounds.
- Analyse impurities present in the water and suggest the methodology for its removal.

Chemistry (Concepts in Chemistry for Engineering)

(1) Periodic properties (6 Lectures)

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, Effective nuclear charge, atomic and ionic sizes, ionization energies, electron affinity, electronegativity, and polarizability, Fajan's rule, Hard soft acids and bases theory and its applications.

(2) Atomic and molecular structure (8 lectures)

Schroedinger equation. Particle in box solutions, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Equations for atomic and molecular orbitals. Molecular Orbital Theory and Molecular orbital diagrams of different homo-nuclear and hetero-nuclear diatomic molecules. Pi-molecular orbital diagram of butadiene and benzene.

Crystal field theory and the energy level diagrams for octahedral and tetrahedral complexes of transition metal ions and their magnetic properties.

Band structure of solids and the role of doping on band structures.

(3) Spectroscopic techniques and applications (8 lectures)

Electromagnetic Spectrum, Principles of spectroscopy.

Electronic spectroscopy – Basic Principles, Lambert-Beer's Law, Woodward-Fisher Rule for conjugated dienes.

Fluorescence and its applications in medicine.

Nuclear magnetic resonance – Basic Principles, Chemical Shift, Spectral interpretation of some simple compounds.

(4) Chemical Thermodynamics and Electrochemistry (8 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of real gases and critical phenomena.

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.

The Nernst equation and applications, Corrosion – Basic principle and mechanism of corrosion.

(5) Stereochemistry and Organic Reactions (8 lectures)

Stereoisomers, configurations and symmetry & chirality, enantiomers, diastereomers, optical activity.

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction. Synthesis of a commonly used drug molecule such as Ibuprofen, Aspirin, Paracetamol, Chloroquine, etc.

(1) Water Technology (6 lectures)

Impurities in natural water, hardness and alkalinity, Disadvantages of hardness i. e. sludge and scale formation, softening of water using lime-soda, zeolite and ion-exchange method, advantages and limitations of these water softening processes, Desalination of water using Reverse Osmosis.

Suggested Text Books

(i) A Textbook of Engineering Chemistry by Dr. Rajshree Khare, S. K. Kataria and Son's Publisher.

(ii) Selected topics in Inorganic Chemistry by W. U. Malik, R. D. Madan & G. D. Tuli, S. Chand Publications.

(iii) Engineering Chemistry by A. Pahari, B. Chauhan, Firewall Media, Infinity Science Press LLC.

(iv) A Textbook of Engineering Chemistry by S. S. Dara, S. Chand Publications.

(v) Applied Chemistry by V. K. Walekar, A. V. Bharati, Tech-Max Publications.

(vi) Organic Chemistry by R. L. Madan, Mc-Graw Hill Publications.

(vii) Elementary Organic Spectroscopy, Revised Edition by Y. R. Sharma, S. Chand Publications.

(viii) Organic Chemistry – Reactions and Reagents by O. P. Agrawal, Goel Publishing House Publications.

(ix) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

Reference Books

(i) Physical Chemistry, by Robert G. Mortimer, Elsevier Academic Press Publications.

(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, Mc-Graw Hill Publications.

(iii) Organic Chemistry by Paula Y. Bruice, Pearson India.

(iv) Physical Chemistry, Third Edition by Gilbert W. Castellan, Adison-Wesley Publishing company.

(v) Physical Chemistry, by P. W. Atkins, Oxford University Press Publications.

(vi) Chemical Principles, Eight Edition, Steven S. Zumdahl, Donald J. DeCoste, Cengage Learning Publications.

(vii) Chemistry – The Molecular Nature of Matter and Change, Fifth Edition by Martin S. Silberberg, Mc-Graw Hill Publications.

(viii) Chemistry, An Introduction to Organic, Inorganic and Physical Chemistry, Third Edition by Catherine E. Housecroft, Edwin C. Constable, Pearson Prentice Hall Publications.

(ix) Organic Chemistry, Third Edition, William Kemp, Palgrave Publications.

(x) Concise Inorganic Chemistry, Fourth Edition by J. D. Lee, Chapman and Hall Publications.

Syllabus for B.E. Semester I / II

Course Code : CHP151 **Course : Chemistry Lab**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits : 1.5**

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.

The students will learn to:

- Estimate the amount of different impurities in water/waste water samples.
- Estimate rate constants of reactions and order of the reaction from concentration of reactants/products as a function of time and to validate adsorption isotherms.
- Measure molecular/system properties such as surface tension, viscosity of aqueous or other industrially important liquids/mixtures etc.
- Synthesize a polymer or drug molecule or nano-material.

List of Experiments for Chemistry Lab

1. Determination of Surface tension of a given liquid/mixture.
2. Determination of Viscosity of a given liquid/mixture.
3. Estimation of total, temporary and permanent hardness present in a given water sample.
4. Estimation of type and extent of alkalinities present in a given water sample.
5. Estimation of Cu and Zn in a brass sample.
6. Study of chemical oscillations or iodine clock reaction and determination of rate constant of the reaction.
7. Estimation of acid value of oil.
8. Estimation of saponification value of oil.
9. Ion Exchange column for removal of hardness.
10. Study of adsorption of acetic acid by charcoal.
11. Synthesis a polymer / drug molecule / nano-material.

Suggested Books/Reference Books

(1) A Textbook on Experiments and Calculations in Engineering Chemistry by S. S. Dara, S. Chand Publications.

(2) Advanced Practical Physical Chemistry by J. B. Yadav, Krishna's Prakashan Media (P) Limited.

(3) Collection of Interesting General Chemistry Experiments, A by A. J. Elias, Universities Press Publications.

(4) College Practical Chemistry by V. K. Ahluwalia, S. Dhingra and A. Gulati, Universities Press Publications.

(5) Advanced Practical Medicinal Chemistry by Ashutosh Kar, New Age International Publisher.

Syllabus of Group 1 - Semester I and Group 2 - Semester II

Course Code: CST151 **Course : Programming for Problem Solving**

L: 4 Hrs.,T: 0 Hrs.,P: 0 Hrs.,Per week **Total Credits : 4**

Course Outcomes

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in C language), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays to solve various matrix operation, searching, sorting and pointers, structure for the formulation of algorithms and programs.
4. To understand basics of file operation and to apply various I/O operations for file handling programming.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm : Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings.

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation) UNIT-VI: File handling Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Text Books

1. Programming in ANSI C : E. Balguruswami McGraw Hill
2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books:

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

Syllabus of Group 1 - Semester I and Group 2 - Semester II

Course Code: CSP151 **Course : Programming for Problem Solving Lab**

L: 0 Hrs.,T:0 Hrs.,P:2 Hrs.,Per week **Total Credits : 1**

Course Outcomes

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision making statements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem using C programming.
3. Understand pointers, structures, unions and apply them to develop programs.
4. Implement file Operations in C programming for a given application.

CREATIVITY INNOVATION AND DESIGN THINKING COURSE SYLLABUS

Course Code : IDT151 **Credits : 1**

L:1Hrs., T:0Hrs., P:0Hrs., Per week

Course Outcomes

C1: Be familiar with processes and methods of creative problem solving C2: Enhance their creative and innovative thinking skills

C3: Practice thinking creatively and innovative design and development

Detailed Topics

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

UNIT 2. Pattern Breaking: Thinking differently , Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking , Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking : Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats , Ethical considerations

UNIT 5. Design for Innovation : Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property : Introduction to intellectual property: Patents, Copyrights©, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Books

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

Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

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

Syllabus Department of Industrial Engineering

Course Code : INT151 **Course : Workshop / Manufacturing Practices (Theory)**

L:1Hrs., T:0Hrs., P:0Hrs., Per week **Total Credits:1**

Course Outcomes

1. Identify the different manufacturing process commonly employed in Industry along with prevailing safety practices.
2. Identify the various tools and equipments to carry out different manufacturing processes accompanied by the inspection of the work part.

Syllabus

Unit-1 Fundamentals of metal cutting, single point cutting tool, fundamental mechanics of metal cutting, fitting operations, and associated measuring and marking tools

Unit-2 Introduction to pattern making for metal casting, different types of carpentry tools, measuring tools and marking tools, holding devices, different types of carpentry joints.

Unit-3 Smithy and Forging, Forging tools like chisels, hammers, types of furnaces, types of coal, Forming operations, Hot working and Cold working of metals.

Unit-4 Metal joining Process, mechanics of welding, types of welding, soldering and brazing, types of joints

Unit-5 Introduction to foundries, Metal Casting, types of sand, Introduction to Molding tools & casting process.

Unit-6 Introduction to Plastic Injection Molding

Suggested Text Book

1. "Elements of Workshop Technology" Hajra S.K, Choudhury A. K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd. Mumbai.

Reference Books

1. Kalpakjian S. and Schmid S. “Manufacturing Engineering and Technology”4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, “Process and Materials of Manufacture”4th Edition, Prentice Hall India 1998.

Syllabus Department of Industrial Engineering

Course Code : INP151 **Course : Workshop/Manufacturing Practices Lab (Practical)**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits :1**

Laboratory Outcomes

On the completion of the course the students shall be able to;

1. Recognize the different manufacturing process commonly employed in the Industry
2. Make the components using required manufacturing process, inspection methods while practicing the requisite safety precautions

Contents

1. Fitting Practice
2. Welding and Soldering Practice
3. Pattern Making Practice
4. Metal Casting Practice
5. Smithy and Forging Practice
6. Machining Practice
7. Plastic Molding Process
8. Glass Cutting Process

Suggested Text Book

1. "Elements of Workshop Technology'" Hajra S.K, Choudhury A.K , Roy Nirjhar Vol. I and Vol .II, Media Promoters and Publishers Private Ltd Mumbai.

Reference Books

1. Kalpak Jain S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, Pearson India Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture", Prentice hall India 1998.

Syllabus for B.E. Semester I / II

Course Code: HUT151 **Course : English**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits : 2**

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as well as communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in an interview and group discussion

SYLLABUS

1. Vocabulary Building

1.1. The concept of Word Formation

1.2. Root words from foreign languages and their use in English

1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives

1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Creating coherence

2.5 Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

3.3 Misplaced modifiers

3.4 Articles

3.5 Redundancies

3.6 Cliches

4. Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

5. Writing Practices

5.1 Comprehension

5.2 Precis Writing

5.3 Essay Writing

5.4 Letter Writing

5.5 Email Writing

6. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations : Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text Books

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

Syllabus for B.E. Semester I

Course Code: HUP151 **Course : English Lab**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 1**

Course objective

1. To enhance competency of communication in English among learners.

Course outcomes

1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills – listening, speaking, reading and writing

List of Practical (2 hours each for each batch) based on unit 6 (oral communication).

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

III Semester
Department of Electronics Engineering

Course Code : MAT254 **Course : Complex Variables and Partial Differential Equation**

L: 2 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 02**

Course Outcomes

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

1. The effective mathematical tools for the solutions of partial differential equations that model physical processes.
2. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Syllabus:

Module I: (8 lectures)

Complex Variable – Introduction to Complex Number : Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module II: (8 lectures)

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

Module III: (8 lectures)

Partial Differential equations: Partial differential equation of first order first degree i.e. Lagrange's form. Linear homogeneous PDE of nth order with constant coefficient, method of separation of variables, Applications of partial differential equations.

Text Books:

1. Higher Engineering Mathematics: B. S. Grewal,43rd ed: Khanna Publishers, Delhi

(India).

2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill,2004.

Reference Books

1. Advanced Engineering Mathematics,8th ed: Erwin Kreyszig Neekunj print process, Delhi.
2. Schaum's Outline of Complex Variables, 2nd ed: Murray R Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, TMH, New Delhi.
3. Advanced Engineering Mathematics, 2nd ed :Jain, Iyengar , Narosa publication.
4. Advanced Engineering Mathematics: H K Dass, S. Chand Publications.

III Semester
Department of Electronics Engineering

Course Code : EET261 **Course : Network Theory**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Outcomes

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

1. Understand basic electrical circuits with modal and mesh analysis.
2. Apply network theorems for the analysis of electrical circuits & Design the filter.
3. Apply Laplace Transform for steady state and transient analysis.
4. Analyze different network function.
5. Analyze two port network circuit with different interconnections.

Syllabus

Module I: (7 Hours)

Node and Mesh Analysis: Node and Mesh analysis, matrix approach of network containing voltage, current sources and reactances, source transformation and duality. Mutual coupled circuits, Dot Convention in coupled circuits.

Module II: (6 Hours)

Network Theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC circuits.

Module III: (4 Hours)

Behaviors of AC circuit and Introduction to Filters: AC circuit analysis with dependent current and voltage sources. Series and parallel resonant circuits. Introduction to band pass, low pass, high pass and band reject filters.

Module IV: (8 Hours)

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, partial fractions, singularity functions, Analysis of electrical circuits using Laplace transform for standard inputs, convolution integral, inverse Laplace transform, evaluation of initial conditions. Transformed network with initial conditions, waveform synthesis, and analysis of RC, RLand RLC networks with and without initial conditions with Laplace transforms.

Module V: (5 Hours)

Transient behavior of Network and Network Functions: Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem.

Module VI: (5 Hours)

Two Port Network: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, inter connections of two port networks.

Text Books

1. M. E. Van Valkenburg, " Network Analysis", Prentice Hall, 2006.
2. Roy Choudhury, " Networks and Systems," New Age International Publications, 1998.3.W . H . Hayt and J. E. Kemmerly, " Engineering Circuit Analysis", McGraw Hill Education, 2013.

Reference Books

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

III Semester
Department of Electronics Engineering

Course Code : ENT251 **Course : Electronic Devices and Circuits**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 4**

Course Outcomes

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

1. Describe the characteristics and working principle of semiconductor diodes, MOSFET, and BJT.
2. Employ suitable biasing technique for the MOSFET/BJT based design of amplifier circuits.
3. Analyze amplifier circuit at low, mid and high frequencies using low frequency and high frequency models of MOSFET/BJT.
4. Examine the effect of negative feedback on gain, bandwidth, i/p and o/p impedance, and the stability of amplifier.
5. Evaluate the performance parameters such as power conversion efficiency of Class A, B, AB, and C power amplifier, and contrast various types of power amplifiers.
6. Design electronic circuits such as rectifier, voltage regulator, small signal amplifiers comprising of diodes, MOSFET, & BJT using the concepts of biasing, incremental analysis, and negative feedback.

Syllabus

Module I: (6 Hrs)

Diode Models and Circuits : V-I Characteristics of P-N Junction Diode, load line concepts, DC Analysis and Models of P-N Junction Diode, types of special diodes, Applications of PN junction diode — Rectifier, Clipper, Clamper; Zener Diode circuits — shunt regulator, DC power supply.

Module II: (7Hrs)

Bipolar Junction Transistors : Device structure and Physical Operation, Current Components in BJT, Input- Output and Transfer characteristics in CB, CC and CE configuration, Load line concept, Biasing techniques, Bias Stability, The Ebers-Moll Model and small signal model of BJT, Applicationsof BJT.

Module III :(8Hrs)

Field-effect Transistors : FET, MOSFET – Classification, Construction, Physical Operation, Volt-Ampere Characteristics, DC operating point, biasing the MOSFET; small signal model of the MOSFET, small signal analysis, Applications of MOSFET: Switch, Amplifier, Digital Logic Inverter.

Module IV: (10Hrs)

Basic BJT & MOSFET Amplifiers : Classification of amplifiers, distortions in amplifiers, basic configurations of MOSFET amplifier, Single-stage and Multi-stage transistor amplifiers, low frequency and high frequency response, effect of emitter (or source) bypass capacitor on the frequency response of amplifier, High frequency model of the MOSFET, Miller's theorem.

Module V: (7Hrs)

Feedback amplifier & Stability : General Feedback amplifier Structure, Properties of Negative Feedback, Basic Feedback Topologies, The Stability of Amplifier, Transfer Function of the feedback Amplifier, Poles and Zeros of Amplifier Transfer Function, Effect of Feedback on the amplifierpoles, phase margin, unity gain band width, compensation of the cascaded amplifier.

Module VI: (7 Hrs)

Power Amplifiers : Audio power amplifier, class-A/class-B/class-C; push-pull amplifier, class-AB power amplifier.

Text Book

1. Microelectronics Circuits: Theory and Applications: Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Seventh Edition, Oxford University Press, 2017.

Reference Books

1. Electronic Circuits: Analysis and Design: Donald Neamen, Third Edition, McGraw- Hill Publication, 2006.
2. Solid State Electronic Devices: G. Streetman, and S. K. Banerjee, Seventh edition, Pearson, 2014.
3. Semiconductor Physicsand Devices: Basic Principles: Donald Neamen, Fourthedition, McGraw-Hill, 2011.
4. Millman's Integrated Electronics: Jacob Millman, Christos Halkias, Chetan Parikh, Second edition, McGraw Hill Education, 2017.
5. Microelectronics: Behzad Razavi, Second edition, Wiley India Pvt. Ltd., 2018.
6. Electronic Devices and Circuits: David A. Bell, Fifth Edition, Oxford 2008.
7. Microelectronic Circuits Analysis and Design: Muhammad H. Rashid, Second edition, Cengage Learning India, 2012.

III Semester
Department of Electronics Engineering

Course Code : ENP251 **Course : Electronic Devices and Circuits Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Describe the characteristics and working principle of semiconductor diodes, MOSFET, and BJT.
2. Employ suitable biasing technique for the MOSFET/BJT based design of amplifier circuits.
3. Analyze amplifier circuit at low, mid and high frequencies using low frequency and high frequency models of MOSFET/BJT.
4. Examine the effect of negative feedback on gain, bandwidth, i/p and o/p impedance, and the stability of amplifier.
5. Evaluate the performance parameters such as power conversion efficiency of Class A, B, AB, and C power amplifier, and contrast various types of power amplifiers.
6. Design electronic circuits such as rectifier, voltage regulator, small signal amplifiers comprising of diodes, MOSFET, & BJT using the concepts of biasing, incremental analysis, and negative feedback.

Syllabus

Experiments based on Syllabus in ENT 251: Electronic Devices andCircuits.

III Semester
Department of Electronics Engineering

Course Code : ENT252 **Course : Digital Circuit Design**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

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

1. Understand number systems conversions and apply the principles of Boolean algebra to manipulate, minimize and design logic circuits using logic gates.
2. Design and analysis of complex hierarchical combinational blocks like multipliers, fast adders etc.
3. Design and analysis of sequential blocks like flip flops, counters, registers, simple finite state machine and similar circuits.
4. Understand and describe the architecture of logic families, memory elements and combinational digital circuits implementation with programmable logic devices.
5. Design, debug and verify simple digital circuits and systems with the aid of HDL (Verilog) and appropriate EDA tool.

Syllabus

Module I: (7 Hrs)

Logic Simplification : Binary Arithmetic, Boolean Algebra and De Morgan's Theorem, SOP & POSforms, Logic Gates, combinational Logic Optimization Techniques.

Module II: (6 Hrs)

Combinational logic Design : Comparators, Multiplexers, Demultiplexer, Encoder, Decoder, Arithmetic Circuit Design, Barrel Shifter, ALU.

Module III: (6 Hrs)

Sequential Logic Design : Latches, Flip flop – S-R, JK, D, T and Master-Slave JK FF, counters, Shift registers, Finite state machines & their implementation.

Module IV: (5 Hrs)

Logic Families and Programmable Devices : Introduction to logic families, comparison and interfacing, Concept of PLDs like ROM, PAL, PLA, CPLDs, FPGA etc. Logic implementation using Programmable devices, Memories & their architecture.

Module V: (5 Hrs)

Overview of Digital Design with HDL : Different methodologies and its implementation process. Introduction to Verilog HDL for Digital Circuit implementation, language constructs.

Module VI: (6 Hrs)

Different Modeling Styles : Structural, sequential behavioral constructs, test bench, synthesis of HDL.

Text Book:

1. Fundamentals of Digital Logic with Verilog: Stephen Brown and ZvonkoVranesic, McGraw Hill, 2nd Edition.

Reference Books

1. Fundamentals of digital circuits: A. Anand Kumar, Prentice-Hall of India, 4th Edition.
2. Modern digital Electronics: R.P. Jain, Tata McGraw Hill, 4th Edition.
3. Digital Electronic Principles: Malvino , PHI, 3rd Edition.
4. Verilog HDL: A Guide to Digital Design and Synthesis: Samir Palnitkar, Prentice Hall PTR, 2nd Edition.

III Semester
Department of Electronics Engineering

Course Code : ENP252 **Course : Digital Circuit Design Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Understand number systems conversions and apply the principles of Boolean algebra to manipulate, minimize and design logic circuits using logic gates.
2. Design and analysis of complex hierarchical combinational blocks like multipliers, fast adders etc.
3. Design and analysis of sequential blocks like flip flops, counters, registers, simple finite state machine and similar circuits.
4. Understand and describe the architecture of logic families, memory elements and combinational digital circuits implementation with programmable logic devices.
5. Design, debug and verify simple digital circuits and systems with the aid of HDL (Verilog) and appropriate EDA tool.

Syllabus

Experiments based on ENT 252 Syllabus in Digital Circuit and Verilog.

III Semester
Department of Electronics Engineering

Course Code : ENT253 **Course : Signals and Systems**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 4**

Course Outcomes

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

1. Skillfully use the concepts of mathematics for the analysis of signals and systems in time and frequency domain.
2. Appreciate the importance of Fourier series and Fourier transform techniques
3. Analyze the Continuous Time signals and systems through Laplace Transform
4. Recognize the need for of discretizing a signal and importance of Nyquist Criterion
5. Build necessary foundation for Digital Signal Processing

Syllabus

Module I:(8 Hrs)

Introduction to Signals and Systems: Elementary continuous & discrete time signals, basic operations on signals, classification of signals, introduction to system and system classification.

Module II: (8 Hrs)

Time domain analysis of Continuous Time(CT) system : Classical method, convolution integral and their properties, causality, correlation, stability, step response, impulse response of interconnected systems

Module III: (8 Hrs)

Fourier series analysis of CT Periodic signals : Representation, properties, Fourier spectrum, Gibb's phenomenon, introduction to Discrete Time Fourier Series (DTFS)

Module IV:(7 Hrs)

Continuous Time Fourier transform (CTFT): Properties, FT of periodic signals, modulation, system analysis with FT

Module V:(8 Hrs)

Overview of Laplace Transform: Need of Laplace Transform, Unilateral and bilateral Laplace Transform, properties criterion, concept of Region of Convergence (ROC), inverse of Laplace Transform, the S-planeand BIBO stability criterion and Causality, Transfer function, Solution of differential equations, Analysis of LTI System Using L.T. and Applications, relation between Fourier Transform and Laplace Transform.

Module VI: (6 Hrs)

Sampling : Nyquist Criteria of sampling, sampling theorem, aliasing, signal reconstruction, analog to digital conversion, signal transmission though linear system, distortion less transmission through a system, linear phase system, ideal filter, signal and system bandwidth, relationship between band width and rise time.

Text Book

1. Signals and Systems; A.V. Oppenhemn, A.S. Willsky and Hamid Nawab; Pearson publication, 2nd edition 2015

Reference Books

1. Principles of Linear Systems & Signals: B.P.Lathi, Oxford Press , Second Edition, 2009
2. Signals and Systems : Simon Haykin, Barry van Veen; John Wiley and Sons, 2nd edition, 2003.
3. Signals and Systems : A. NagoorKani, Mc Graw Hill Education, 2015

III Semester
Department of Electronics Engineering

Course Code : CST261 **Course : Data Structures and Algorithms**

L: 2 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 2**

Course Outcomes

1. For a given algorithm student will be able to analyze he algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will be able to implement it.
3. For a given problem of Stacks, Queues and linked list student will be able to implement it and analyze the same to determine the time and computation complexity.
4. Student will be able to write an algorithm for Insertion Sort, Quick Sort, Merge Sort, & Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will be able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Syllabus

Module I

Introduction : Basic Terminologies: Elementary Data Organizations, Data Structure Operations, Abstract Data Typesandtheir Characteristics; Algorithms: Definition, Characteristics, Analysis of an Algorithm, Asymptotic Notations, Time-Space tradeoffs.

Searching : Linear Search, Binary Search techniques and their complexity analysis.

Module II

Stacks and Queues : ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks and multiple stacks: Expression Conversion and evaluation - corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Operations on each type of Queues: Algorithms and their analysis. Double Ended Queues and Priority Queues.

Module III

Linked Lists : Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue; Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Trees : Basic Tree Terminologies, Different types of Trees: Binary tree, Binary Search Tree, Tree operations on each of the trees and their algorithms with complexity analysis; Applications of Binary Trees; BTree, B + Tree: definitions, characteristics and operations; Threaded Binary Tree, AVL Tree: Introduction and applications.

Module IV

Sorting and Hashing : Objective and properties of different sorting algorithms: Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods;Hashing: Introduction and Significance, Closed and Open Hashing, Collision Resolution Techniques.

Graph : Basic terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Text Books

1. Ellis Horowitz, Sartaj Sahni & Susan Anderson - Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
2. Mark Allen Weiss; Data Structures and Algorithm Analysisin C; Second Edition; Pearson Education; 2002

Reference Books

1. Thomas H. Corment, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein; Introduction to Algorithms;' Third Edition; PHI Learning; 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms; Second Edition; Universities Press; 2008.
3. G.A.V.Pai;DataStructuresandAlgorithms:Concepts,TechniquesandApplication;First Edition; McGraw Hill; 2008.

III Semester
Department of Electronics Engineering

Course Code : CSP261 **Course : Data Structures and Algorithms Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

1. For a given search problem student will able to apply appropriate algorithm (linear search and/or binary search) for efficient searching.
2. For an identified scenario or problem statement, the student will be able to apply and implement linear data structures (stack, queue and linked lists).
3. Student will able to write and execute algorithms for Insertion Sort, Quick Sort, Merge Sort, and Heap Sort and analyze them for time requirements.
4. Student will able to implement graph search and tree traversal algorithms.

Syllabus

Experiments based on CST261 Syllabus in C | C++.

Reference Books

1. K R. Venugopal and Sudeep. R Prasad; Mastering C; Second Edition; McGraw Hill; 2015.
2. Ellis Horowitz, Sartaj Sahni& Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
3. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.

III Semester
Department of Electronics Engineering

Course Code : CHT251 **Course : Environmental Studies**

L: 2 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 0**

Course Outcomes

1. Students will get sufficient knowledge regarding different types of environmental pollutions, their causes and detrimental effects on environment. This will highlight the extent of pollution in the surrounding we live and its major causes.
2. Students will realize the need to change their approach so as to perceive our environmental issues correctly, using practical approach based on observations and self-learning.
3. Student becomes conversant with recent waste management techniques such as E-waste recycling and management.
4. Students will gain knowledge about the modes for sustainable development, importance of green energy and processes leading to sustainability such as green chemistry.
5. At the end of the course, it is expected that student will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be taken to protect the environment from getting polluted. This will enable human being to live in more sustainable manner.

Syllabus

Principle of contaminant behavior and recent trends in environmental pollution control

Module I: (4 Hrs)

Air pollution and its control techniques: Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution.

Natural pathways for degradation : Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle.

Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs).

Techniques to control Air pollution, Ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

Module II: (2 Hrs)

Noise pollution and its control techniques : Introduction to noise pollution and its causes Noise pollution control: Recent advances in noise pollution control and benefits.

Module III: (5 Hrs)

Soil pollution and its control techniques : Solid waste management: Composting, vermi culture, landfills, hazardous waste treatment, bio remediation technologies, conventional

techniques(landfarming, constructed wet lands), and phy to remediation.

Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals.

Module IV: (6 Hrs)

Water pollution and its control techniques : Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics

Techniques to control water pollution: Conventional waste water treatment-(types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal).

Case studies: (2 Hrs)

Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills

Module V: (2 Hrs)

E-waste: Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

Module VI: (5 Hrs)

Environmental Sustainability: Role of Green technology: Concept of green technologies, categories, goals and significance, sustainability Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation

Different government initiatives (2 Hrs) Reference Books

1. Benny Joseph, Environmental Studies (Second Edition), Mc Graw Hill Education (India) Private Limited.
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3. P Aarne Vesilind, J. Jeffrey Peirce, Ruth F. Weiner, Environmental Pollution and Control,3rdEdition Imprint: Butterworth-Heinemann, Published Date: 19th September 1990.
4. D. D. Mishra, S. S. Dara, A Text book of Environmental Chemistryand Pollution Control, S. Chand & Company Ltd. Sultan Chand & Company
5. Microbial Degradation of Xenobiotics, Editiors : Singh, Shree Nath , Springer-Verlag Berlin Heidelberg.
6. Anastas, P.T. & Warner, J.C. 1998, Green Chemistry: Theory & practice, Oxford University Press.
7. Thangavel, P. & Sridevi, G. 2015, Environmental Sustainability: Role of Green technologies, Springer publications.

IV Semester
Department of Electronics Engineering

Course Code : ENT254 **Course : Digital Signal Processing**

L: 03 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

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

1. Describe discrete time signals in different forms and analyze the LTI system in frequency domain.
2. Process the signal in Z domain for various discrete time systems
3. Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) filters, and evaluate the performance to meet expected system specifications
4. Analyze the various finite world length effects while rounding and truncating the signal, multi rate signal processing, fundamentals of DSP processor.

Syllabus

Module I: (4 Hrs)

Discrete Time Fourier Transform (DTFT): Analysis of LTI system using DTFT, block diagram and signal flow graph representation of linear constant coefficient difference equations

Module II: (7 Hrs)

Z-transform: Z-transform and its properties, analysis of LTI discrete time system using Z transform, Relation between Laplace and Z transform, Inverse Z-transform, Unilateral Z- transform.

Module III: (7 Hrs)

Discrete Fourier Transform (DFT): Frequency Domain sampling, DFT and its properties, filtering of long data sequences using overlap-save method and overlap-add method, Radix-2 Fast Fourier Transform (FFT) algorithms

Module IV: (7 Hrs)

Design of FIR filter: Digital filter concepts, FIR filters Design techniques: Fourier series, Windows (Rectangular, Bartlett, Hanning, Hamming, Blackman, Kaiser) and Optimal frequency sampling, structures for FIR systems

Module V: (5 Hrs)

Design of IIR filter: Impulse invariance transformation, Bilinear Transformation, Design of Butterworth and Chebyshev filters, structures for IIR systems.

Module VI: (5 Hrs)

DSP hardware and Finite word length effects: Quantization by truncation and Rounding, Quantization of Input data and filter coefficients, Digital Signal Processing applications, introduction to DSP processors.

Text Book

1. Digital Signal Processing: Principles, Algorithms & Applications, John G. Proakis & Dimitris G. Manolakis, PHI, 4th Edition

Reference Books

1. Digital Signal Processing: AComputerbased Approach, Sanjit K. Mitra, 4th Edition Mc-GrawHill.
2. Discrete Time Signal Processing, Alan V. Oppenheim & Ronald W. Schafer, 3rdEdition, Pearson.
3. Digital Signal Processing, Thomas J. Cavicchi, Wiley Publication, Student Edition.
4. Digital Signal Processing, A NagoorKani, 2nd Edition Mc-Graw Hill.

IV Semester
Department of Electronics Engineering

Course Code : ENP254 **Course : Digital Signal Processing Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Describe discrete time signals in different forms and analyze the LTI system in frequency domain.
2. Process the signal in Z domain for various discrete time systems
3. Design Finite Impulse Response (FIR) and Infinite Impulse Response (IIR)filters, and evaluate the performance to meet expected system specifications
4. Analyze the various finite world length effects while rounding and truncating the signal, multiratesignal processing, fundamentals of DSP processor.

Syllabus

Experiments based on ENT 254(Digital Signal Processing) Syllabus.

IV Semester
Department of Electronics Engineering

Course Code : ENT255 **Course : Analog Circuits**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 4**

Course Outcomes

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

1. Understand the operating principle of MOSFET differential amplifier and its analysis.
2. To analyze inverting and non- inverting configurations of operational amplifier with negative feedback, evaluate performance parameters of operational amplifier and design basic linear and nonlinear Op-amp circuits.
3. Use operational amplifier in the design of Oscillators, Filters, waveform generators and comparator circuits.
4. Use IC 555 Timer, ADC/DAC for designing electronic circuits for desired applications and describe the operation PLL IC 565 and its applications.
5. Design, test and analyze operational amplifier based circuit/systems, minor projects with the aid of appropriate EDA tools and its hardware implementation with technical report presentation.

Syllabus

Module I:(8Hrs)

Differential amplifier: Basic differential amplifier and its operation using MOS transistor, dccharacteristics, operation with common mode and differential mode input voltage, common mode gain , differential mode gain and CMRR, Constant current source and current mirror circuits, output stages, design ofdifferential amplifier for given specifications.

Module II: (7 Hrs)

Op-amp fundamentals: Characteristics of operational amplifier, open loop Op-amp, basic inverting and non- inverting Op-amp amplifiers with negative feedback, Op-amp parameters & their analysis.

Module III: (8 Hrs)

Op-amp linear applications: Voltage follower, summing amplifiers, integrators and differentiators, log,antilog circuits, difference amplifiers & instrumentation amplifiers, Current to voltage and voltage to current converters.

Module IV: (8 Hrs)

Oscillators and Active filters design: Precision rectifiers, oscillators: basic concept, transistorized sinusoidal oscillators, Op-amp based sinusoidal oscillators, design of Active filters.

Module V:(7 Hrs)

Op-amp Non-linear applications: Clipper, Clamper, Comparators, Schmitt trigger circuits, Comparator IC 339,Triangular wave generator, multivibrator circuits using op-amps, Sample/Hold circuits, Digital to analog converters, Analog to digital converters.

Module VI: (7 Hrs)

Timer and PLL ICs: Timer IC 555: Internal block schematic, multivibrator configurations, PLL & its applications. Basic concept and configurations of Switched capacitor circuits.

Text Book

1. Microelectronics Circuits: Theory and applications: A. S. Sedra, Kenneth C.Smith, Arun N. Chandorkar, Seventh Edition, Oxford university Press,2017.

Reference Books

1. Linear Integrated Circuits: D. Roy Choudhary, Shail Jain, 4th Edition, New Age International.
2. Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Edition: Sergio Franco, TMH,
3. Operational Amplifiers: G. B. Clayton,5th Edition, International Edition
4. Operational Amplifiers and Linear Integrated Circuits, 4th Edition: Coughlin Driscoll,PHI.
5. Introduction to Operational Amplifier theory and applications: J.V.Wait, L.P.Huelsmanand G A Korn, McGraw Hill,1992.
6. Electronic Circuits: Analysis and design: Donald Neaman,.third Edition, McGraw Hill, 2006.

IV Semester
Department of Electronics Engineering

Course Code : ENP255 **Course : Analog Circuits Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes:

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

1. Understand the operating principle of MOSFET differential amplifier and its analysis.
2. To analyze inverting and non- inverting configurations of operational amplifier with negative feedback, evaluate performance parameters of operational amplifier and design basic linear and nonlinear Op-amp circuits.
3. Use operational amplifier in the design of Oscillators, Filters, waveform generators and comparator circuits.
4. Use IC 555 Timer, ADC/DAC for designing electronic circuits for desired applications and describe the operation PLL IC 565 and its applications.
5. Design, test and analyze operational amplifier based circuit/systems, minor projects with the aid of appropriate EDA tools and its hardware implementation with technical report presentation.

Syllabus

Experiments based on ENT 255 Syllabus in Analog Circuits.

IV Semester
Department of Electronics Engineering

Course Code : ENT256 **Course : Microprocessor and Microcontroller**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

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

1. Understand the architecture of microprocessor & microcontroller.
2. Develop, understand and Analyze programs, select appropriate machine and cross assembler utility of a microprocessor or microcontroller.
3. Acquire the knowledge, techniques & skill to interface external peripheral devices with microprocessor or microcontroller.
4. Design microcontroller-based system to solve the real world problem

Syllabus

Module I:(4Hrs)

8085 architecture and Instructions: Introduction to RISC and CISC processors, Harvard and Von Neumann architecture, Introduction to Intel's 8085, architecture, pin diagram, bus concepts, addressing modes. Instruction set, stack and subroutines- simple & nested, stack manipulation, simple programs.

Module II: (5Hrs)

8085 Timing diagram and Interrupts: Timing diagram sof 8085, Memory mapping, interrupts- concept and structure, interrupt service routines, interrupt programming of 8085.Architecture and interface of 8255 with 8085.

Module III: (6Hrs)

Introduction to Intel's x 86: Introduction to Intel's x86 processor architecture, segmentation, pipelining, addressing modes, memory architectures and management.

Module IV: (7Hrs)

Introduction of Microcontroller: x51 Family Microcontrollers, their Architecture & programming.

Module V:(7Hrs)

Interfacing with x51: Interfacing of Switches & Relays, Stepper motor, LED, SSD, LCD, Analog-to-Digital Converter (ADC), DC motor. Power management in x51controller: Sleep mode, idle mode, Run Mode.

Module VI: (6Hrs)

Commutation Protocols: I/O Port Expansion using RS232, RS422, RS485, Serial Peripheral Interface (SPI), Synchronous Serial Port (SSP) Module, I2C Communication.

Text Books

1. Microprocessor: Architecture, Programming & applications with 8085; Ramesh S.Gaonkar; Penramth International, 5 Edition.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C; Muhammad Ali Mazidi, 2nd Edition, Pearson

Reference Books

1. 8085 Microprocessor: Programming and Interfacing; N. K. Srinath; PHI, 1 Edition.
2. Microcomputer systems: the 8086/8088 family: Architecture, Programming, and Design;Yu-chengnd Liu, Glenn A. Gibson; Prentice-Hall, 2 Edition.
3. Advanced Microprocessors and Peripherals; A. K. Ray & K. M. Bhurchandi; McGraw Hill, 3rdEdition.

IV Semester
Department of Electronics Engineering

Course Code : ENP256 **Course : Microprocessor and Microcontroller Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Understand the architecture of microprocessor & microcontroller.
2. Develop, understand and Analyze programs, select appropriate machine and cross assembler utility of a microprocessor or microcontroller.
3. Acquire the knowledge, techniques & skill to interface external peripheral devices with microprocessor or microcontroller.
4. Design microcontroller-based system to solve the real world problem

Syllabus

Experiments based on ENT 256 Syllabus in Assembly and embedded C .

IV Semester
Department of Electronics Engineering

Course Code : ENT257 **Course : Electromagnetic Fields**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

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

1. Define and recognize different coordinate systems to describe the spatial variations of the physical quantities dealt in electromagnetic field theory.
2. Explain fundamental laws governing electromagnetic fields and evaluate the physical quantities of electromagnetic fields in different media.
3. Understand the working principle of electromagnetic energy conversion and electromagnetic energy storage devices.
4. Deduce and justify the concepts of electromagnetic waves, means of transporting energy or information thus creating a base for Microwave Engineering.

Syllabus

Module I: (3 Hrs)

Introductory Mathematical Preliminaries: Introduction to Cartesian, Cylindrical and Spherical coordinate systems, Divergence, Divergence Theorem.

Module II: (7 Hrs)

Time Invariant Electric Fields: Electric field intensity, flux density, Gauss's law& its Application, Electric potential and potential gradient, Materials in the Electric Field, Interface Conditions, Capacitance, Energy in the Electrostatic Field, Boundary Value Problems: Analytic Methods of Solution, Laplace & Poisson's equation.

Module III: (7 Hrs)

Time Invariant Magnetic Fields: Current density and continuity equation, Biot-Savart's law, Ampere's circuital law and applications, Magnetic flux and Flux density, Boundary conditions, Classification of Magnetic Materials

Module IV: (4 Hrs)

Introduction to Time-Varying Fields: Faraday's law in integral and differential form, Ohm's law, Lenz's law, electromotive force (emf) and work, inductance (mutual and self), displacement current.

Module V: (7 Hrs)

Maxwell's Equations: Maxwell's equations for steady fields, Maxwell's equations for time varying fields. Interface Conditions for the Electromagnetic Field, Electromagnetic wave equation, wave propagation in free space, in a perfect dielectric and perfect conductor, skin effect, Scalar and Vector magnetic potentials.

Module VI: (7 Hrs)

Electromagnetic Waves: Poynting vector, Poynting theorem, reflection and refraction of uniform plane wave at normal incidence plane, reflection at oblique incident angle, polarization.

Text Book

1. Field and Wave Electromagnetics: David Cheng, Pearson India, 2nd Edition, 2014

Reference Books:

1. Fundamentals of Applied Electromagnetics: Fawwaz T. Ulaby, Umberto Ravaioli, Pearson India, 6thedition, 2014.
2. Engineering Electromagnetics: Nathan Ida, Springer Science 2nd Edition, 2008.
3. Principles of Electromagnetics: Matthew N. O. Sadiku, 6th edition.
4. Engineering Electromagnetics: William Hayt, John. R. Buck, Mc-Graw Hill Education, India, 8th Edition.
5. Electromagnetic Waves and Radiating Systems: Edward C. Jordan, Keith G. Balmain, Pearson India, 2nd Edition 2015.
6. Electromagnetics with Applications: John Kraus, Mc-Graw Hill Education, India, 5th Edition, 1999.

IV Semester
Department of Electronics Engineering

Course Code : IDT254 **Course : Biological Science**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

Upon the completion of this course students will be able to

1. Understand the basics of biology regarding the life structures and process.
2. Understand the principles of energy transaction in living systems.
3. Understand the process of generation of Bioelectric signals, Bioelectric Devices and recent advances in Biosciences.

Syllabus

Module I: (6 Hrs)

Introduction: Engineering perspective of Biological Sciences, Fundamental differences between science and Engineering- case studies; Hierarchy and classification of life forms, Levels of organization of life-cell,tissues, organs, system and organism ,Anatomy and physiology.

Module II: (6 Hrs)

Biomolecules and Enzymes: Biomolecules as basic building block of all forms of life, structure and function of carbohydrates, proteins and Amino acids, Lipids, Nucleic acids, Vitamins and Minerals, Enzymology- Introduction, classification and mechanism of action

Module III: (6 Hrs)

Metabolism / Bioenergetics: Fundamental principles of energy transactions (Thermodynamics) as applied to biology,Entropychangesinbiologicalsystems,freeenergy,equilibrium,processof synthesis and breakdown of glucose.

Module IV: (6 Hrs)

Genetics: Introduction to Genetics, genetic codes, Expression and Transmission of genetic Information, concept of DNA cloning , single gene disorders in humans.

Module V: (6 Hrs)

Bioelectric signals and devices: Resting and action potential, propagation of bioelectric signals, various bioelectric signals- ECG, EEG, EMG; Electrode electrolyte interface, Biosensors and Diagnostic devices.

Module VI: (5 Hrs)

Advance Topics in Biosciences: Current trends in the field of cell and Molecular biology, Biomimetics, Bioinformatics, Nanobiotechnology.

Text Book

1. Biology: A Global Approach: Campbell, N. A.; Reece, J. B; Urry, Lisa; Cain, M. L; Wasserman, S. A.; Minorsky, P.V.; Jackson, R. B. Pearson Education Ltd.

Reference Books

1. Molecular Cell Biology. W. H. Freeman.: Lodish H, Berk A, Zipursky SL, et al. (2000).
2. Lehninger Principlesof Biochemistry: Lehninger, A. L. , Nelson, D. L. ,& Cox,M.M (2000). Newyork, Worth Publishers.
3. Genes VII: Lewin B.(2000). Oxford University Press.
4. Medical Instrumentation Application and Design: John G. Webster, ,4th edition, Wiley India,2015.

V Semester
Department of Electronics Engineering

Course Code : EET 361 **Course : Control System**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

Upon the completion of this course, the students:

1. Will be able to determine the transfer function of the system by different methods.
2. Will be able to understand various time response specifications for improving the system response.
3. Will be able to determine the stability of the systems and method of design by root locus.
4. Will be able to understand the concept of frequency domain analysis of a system.
5. Will be able to understand the concept of modern control system theory for design and analysis of a system

Syllabus

Module I: (6 Hrs)

Introduction to control problem- Industrial Control examples. Mathematical modeling, differential equations, transfer function of system response. potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Module II: (6 Hrs)

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Proportional, integral and derivative systems.

Module III: (6 Hrs)

Feedback control systems- Stability, steady-state accuracy, transient accuracy, stability concept, relative stability, Routh Hurwitz stability criterion.

Module IV: (6 Hrs)

Root locus method of design. Effect of adding pole and zero in proximity of imaginary axis. Lead and lag compensation.

Module V: (6 Hrs)

Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain.

Module VI: (6 Hrs)

State variable Analysis- Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control system.

Text/Reference Books:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Automatic Control Systems, 9th Edition, Farid Golnaraghi, Benjamin C. Kuo , June.
3. Modern Control Engineering; Katsuhiko Ogata; Prentice Hall. , 2010 - Technology & Engineering.
4. Control Systems Engineering, I. J. Nagrath, M. Gopal, New Age International Publishers, 2005 Edition.
5. Automatic Control System by Hasan Saeed

V Semester
Department of Electronics Engineering

Course Code : ENT 351 **Course : Electromagnetic Waves**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

After completion of the course student will be able to:

1. understand the wave propagation in transmission lines and waveguides. Use the smith chart as a graphical tool to solve impedance matching issues.
2. explain the principle of radiation from an antenna/array, its characteristics, structure, design, limitations and tradeoffs.
3. apply the knowledge of transmission lines, waveguides and antenna propagation for different communication systems.

Syllabus

Module I: (8 Hrs)

Transmission Lines: Types of Transmission lines, Applications of Transmission lines, Equivalent circuit of a pair of Transmission lines, Primary constants, transmission line equations, Secondary constants, Distortion less Transmission lines, Phase & Group velocities, Input impedance of Transmission line, Loading of Lines, RF lines, Lossless transmission lines, Relation between reflection coefficient, load and characteristic impedance, Relation between reflection coefficient and voltage standing wave ratio, Line of different lengths $\pi/8$, $\pi/4$, $\pi/2$, Losses in Transmission lines, Impedance transformation, Impedance matching with single and double stubs.

Module II: (4 Hrs)

The Smith Chart and its applications: Introduction to Smith Chart, Admittance Smith Chart and Applications of transmission lines: Impedance Matching Techniques, using transmission line sections as circuit elements.

Module III: (6 Hrs)

Guided waves: Waves between parallel planes, TE and TM waves, characteristics of TE and TM waves, TEM waves, Velocities of propagation, Wave Impedance.

Wave guides: Rectangular wave-guides, TE & TM modes in wave-guides, Wave Impedance in rectangular waveguides.

Module IV: (6 Hrs)

Antenna Fundamentals: radiation from an alternating current element, Induction field, radiation field, power radiated by a current element, radiation by a half wave dipole, radiation resistance of dipole & monopole, Isotropic radiator.

Antenna Parameters: Radiation pattern, power pattern, field pattern Radiation intensity, Antenna impedance, mutual impedance, gain and directivity, bandwidth, Polarization, efficiency, effective length, area or aperture, scattering loss, physical aperture, half wave antenna, effective length, front to back ratio, Antenna beam width and side lobes.

Module V: (6 Hrs)

Basic Antennas: Monopole and Dipole antenna, two element array and their directional characteristics, linear array analysis, broadside and end fire arrays, pattern multiplication and binomial arrays. Phased array antenna, Microstrip antennas -Radiation from rectangular and circular patches, feeding techniques, Introduction Smart Antenna

Module VI: (6 Hrs)

Practical antennas: Horn antenna, Parabolic reflector antenna etc.

Radio Wave Propagation: Propagation in free space, Friss Transmission formula, Path loss and Link budget calculation, Multipath Fading, tropospheric propagation, Super refraction.

Text Book

1. Electromagnetic waves & Radiating Systems- E.C. Jordan & K.G. Balmain, Prentice Hall, India, 2nd Edition.
2. Antenna Theory: Analysis and Design – Constantine A. Balanis, John Wiley & Sons, 3 rd Ed., 2009.

Reference Books

1. Electromagnetic Waves by R.K. Shevgaonkar, Tata McGraw Hill India, 1st Edition, 2005.
2. Engineering Electromagnetics by N. Narayana Rao, Prentice Hall, 3rd Edition, 1997.
3. Fields and Wave Electromagnetics by David Cheng, Prentice Hall, 2nd Edition, 2002.

V Semester
Department of Electronics Engineering

Course Code : ENT 352 **Course : CMOS Digital Circuit Design**

L: 03hrs, T: 01 Hr., Per Week **Total Credits : 4**

Course Outcomes

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

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

Syllabus

Module I: (8 Hours)

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

Module II: (8 Hours)

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

Module III: (7 Hours)

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

Module IV: (9 Hours)

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

Module V: (7 Hours)

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

Module VI: (6 Hours)

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

Text Book

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

Reference Books

1. CMOS VLSI Design: A circuits and systems perspective: N. Weste and K. Eshranghian, 2nd edition, PHI
2. CMOS Digital Integrated Circuits Analysis & Design: S M Kang, Yusuf Lablebici, 3rd edition TMH3.V L S I Design Technique for Analog and Digital Circuit: Randel Geiger, P Allen, N Strader, 2nd edition TMH
4. Introduction to VLSI System: Carver Mead, Lynn Conway, 1st edition Addison- Wesley
5. MOS Integrated Circuits- Theory, Fabrication, Design and System Applications of MOS LSI: William M. Penny, Lillian Lau, Van Nostrand Reihold Company. 1st edition
6. Basic VLSI Systems and Circuits: Dougles Pucknell and K. Eshraghian 3rd edition, PHI

V Semester
Department of Electronics Engineering

Course Code : ENP352 **Course : CMOS Digital Circuit Design Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

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

Syllabus

Experiments based on ENT353 Syllabus.

V Semester
Department of Electronics Engineering

Course Code : ENT 353 | **Course : Electronic Instrumentation**

L: 03hrs, T: 00 Hr., Per Week | **Total Credits : 3**

Course Outcomes

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

1. Understand the working principle of instrumentation system.
2. Design instrumentation system suitable for required parameter measurement.
3. Describe working principle of various sensing devices.

Syllabus

Module I: (6 Hrs)

Errors and analysis in measurement, Basics of Instrumentation System, components: Sensing elements, transducers, actuators, display, introduction to transducers and their classification and types.

Module II: (5 Hrs)

Instrumentation systems for temperature measurement, Contact type sensors and non-contact type sensors.

Module III: (4 Hrs)

Instrumentation system for Pressure Measurement, classification of pressure: High and low pressure measurement sensors.

Module IV: (6 Hrs)

System for measurement displacement, force and torque: Resistive, inductive and capacitive transducers for measurement of displacement, force, torque, velocity and acceleration.

Module V: (8 Hrs)

Instrumentation for real world monitoring: Standards, working principle, design criterion: PH, humidity, magnetic flux, electrical conductivity. Light intensity, air monitoring.

Module VI: (6 Hrs)

Grounding and shielding, isolation: Grounding concepts, ground loop, isolation amplifier, instrumentation amplifier, 4 -20 mA current converter for instrumentation, and Case study of parameter acquisition, processing and display methods.

Text Book

1. Electrical & Electronic Instruments & Measurement by A. K. Sawhney, Dhanpat Rai and Co. 19th Edition, 2015.

Reference Books

1. Electronic Instrumentation & Measurement Technique by W.D. Cooper & A.D. Helfrick, Prentice Hall, 3rd revised Edition, 1985.
2. Process Measurement and Analysis by B. G. Liptak, Chilton Book Company, 4th Edition, 2003.

V Semester
Department of Electronics Engineering

Course Code : ENP354 **Course : Instrumentation and Control Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Understand the working principle of instrumentation system.
2. Design instrumentation system suitable for required parameter measurement.
3. Describe working principle of various sensing devices.

Syllabus

Experiments based on ENT 353 Syllabus

V Semester
Department of Electronics Engineering

Course Code : ENT 355 -1 **Course : Embedded System Design & RTOS**

L: 03hrs, T: 00 Hr. P: 00 Hrs, Per Week **Total Credits : 3**

Course Outcomes

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

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

Syllabus

Module I: (6Hrs)

Introduction to embedded System, RISC Principles, ARM Processor Families, Processor ARM, Thumb, Thumb2 Instruction, AMBA Bus Architecture.

Module II: (6Hrs)

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

Module III: (6Hrs)

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

Module IV: (6Hrs)

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

Module V: (6Hrs)

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

Module VI: (5Hrs)

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

Text books

1. The Definitive Guide to the ARM Cortex-M0: Joseph Yiu, Elsevier, (1/E) 2011.

Reference Books

1. Freescale ARM Cortex-M Embedded Programming, Mazidi and Naimi ARM
2. An embedded software primer: David E Simon, Pearson education Asia, 2000.
3. Micro C/OS II The Real Time Kernel: Jean J. Labrosse, CMPBooks,(2/E) 2002 4.Embedded Linux Primer: christopher Hallinan, Pearson (1/E) 2007

V Semester
Department of Electronics Engineering

Course Code : ENP355-1 **Course : Embedded Systen Design and RTOS LAB**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

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

Syllabus

Experiments based on ENT 355-1 Syllabus in Assembly and embedded C .

V Semester
Department of Electronics Engineering

Course Code : ENT355-2 **Course : Mechatronics**

L: 03 Hrs, T: 00 Hrs, P: 00 Hrs, Per Week **Total Credits : 3**

Course Outcomes

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

1. Employ the knowledge of Mathematics, Science, and Engineering.
2. Indentify sensors and actuators, design Mechatronics component, system or process to meet desired needs.
3. Conduct experiments to demonstrate the knowledge of automation,supervisory control and state-of-the-art technologies/products

Module - I : (6 Hrs)

Introduction : Mechatronics key elements, design processes and issues, Modeling and simulation of physical system, Electrical system, Mechanical translation-rotation system, electromechanical coupling, Ball screws, Electronic cams, Indexing mechanisms.

Module - II : (6 Hrs)

Sensors : Sensor characteristics and classification, Position sensor, Gas sensors, Piezoelectric sensor, Proximity sensor, Load Cell, Accelerometer, Gyroscope, Inclinometer, Wearable sensors for robotic applications, Signal conditioning and data conversion.

Module - III : (6 Hrs)

Actuators : Direct current motor and drive, Stepper motor and drives, Servo-motor and drive, Piezoelectric actuators, MEMS actuators , Shape memory alloy Actuator, Pneumatic and fluid power actuation, Power estimation of actuator.

Module - IV : (6 Hrs)

Industrial automation : Industrial revolutions, Basic Components of automation, PLC commissioning and installation, Architecture of PLC, PLC programming techniques, Ladder logic programming, Advanced instructions of PLC, Introduction to programmable automation controller (PAC)

Module - V : (6 Hrs)

Components and features, SCADA Scripting, Graphical Animation, PLC networking and Communication, Introduction to Human machine interface (HMI)

Module - VI : (5 Hrs)

Case studies: Industry 4.0, Defence systems, Automotive Electronics, Biomedical Systems, Agriculture

Text Books

1. Devdas Shetty and Richard A. Kolk, Mechatronics System Design, CENGAGE Learning , Second Edition ,Indian reprint, 2012
2. John Hackworth and F. Hackworth Jr, Programmable Logic Controllers , Pearson Education.

Reference Books

1. W. Bolton, Mechatronics, Pearson Education Asia, Third Indian reprint 2001
2. David G. Alciatore and Michael B.Hisland, Introduction to Mechatronics and measurement Systems, Tata McGraw hill, Third Edition, 2007
3. Nitaigour Mahalik, Mechatronics, Principles, Concepts and application, McGraw Hill Publication, Indian seventeenth reprint 2014.

V Semester
Department of Electronics Engineering

Course Code : ENP355-2 **Course : Mechatronics Lab**

L: 00 Hrs, T: 00 Hrs, P: 02 Hrs. Per week **Total Credits : 1**

Course Outcomes

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

1. Employ the knowledge of Mathematics, Science, and Engineering.
2. Indentify sensors and actuators, design Mechatronics component, system or process to meet desired needs.
3. Conduct experiments to demonstrate the knowledge of automation,supervisory control and state-of-the-art technologies/products

Syllabus

Experiments based on ENT355-2 syllabus covers fundamentals of PLC programming techniques, PLC hardware platform, SCADA development process and industrial process simulation.

The programming platforms are SIMATIC STEP 7 (TIA Portal), Connected Components Workbench (CCW Portal), and CODE SYS manufacturer independent IEC 61131-3 automation software along with PLCs like SIEMENS 1200, ALLEN BRADLEY Micro 820 PLC.

V Semester
Department of Electronics Engineering

Course Code : ENT 355-3 **Course : Digital Image Processing**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Apply mathematical tools to obtain basic features from an image and summarize image formation process through mathematical modelling.
2. Implement basic image processing algorithms for image enhancement and restoration.
3. Examine segmentation methods on image into its constituent regions and objects to extract the features from the image.
4. Evaluate modern methods of image processing and fundamentals of color image processing.
5. Formulate image compression algorithms using basic coding techniques

Syllabus

Module I: (6 Hrs)

Digital Image Fundamentals: Elements of digital image processing systems; Elements of visual perception, image formation models, sampling and quantization, basic relationships between pixels, image geometry, digital image representation, Imaging modalities, mathematical tools used in Digital Image Processing.

Module II: (6 Hrs)

Image Enhancement: Image Enhancement in spatial domain: Basic gray level transformations, Histogram Processing, Fundamentals of spatial filtering, Smoothing Spatial Filters, Order Statistic Filters, Sharpening Spatial Filters.

Image Enhancement in Frequency domain: Basics of filtering in the frequency domain, Image smoothing, sharpening using frequency domain filters.

Module III: (6 Hrs)

Image Transforms: Two dimensional Orthogonal and Unitary Transforms, Properties of Unitary Transform; 2D Discrete Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Haar Transform, KL Transform, Wavelet Transform: CWT, DWT.

Module IV: (5 Hrs)

Image Restoration: Basic model of image degradation/restoration processes; Types of image blur, linear position-invariant degradation, estimating degradation function, linear and nonlinear image restoration techniques, Inverse filtering, Wiener filtering and restoration in the presence of noise.

Module V: (6 Hrs)

Image Segmentation and Feature Extraction: Detection of discontinuities, edge and boundary detection, Localized feature extraction, Hough transform. Image segmentation: Segmentation using thresholding, Region based segmentation: region growing split and merge techniques. Graph cut algorithm.

Module VI: (6 Hrs)

Image Compression and Color Image Processing: Fundamentals of Image Compression, information theory, image compression models, Basic compression methods, JPEG image compression. Color image processing: Color spaces; Color image demosaicing: problem definition, concept of Color Filter Array (CFA) - Bayer pattern.

Text Books

1. Digital Image Processing by R. C. Gonzalez & R. E. Woods, Pearson education, 4th Edition, 2018.
2. Digital Image processing by S. Jayaraman, S. Esakkirajan, T. Veerakumar, Tata McGraw- Hill Education, 15th reprint 2015.

Reference Books

1. Fundamentals of Digital Image Processing by Anil K. Jain, PHI Learning, Indian edition.
2. Digital Image Processing using MATLAB by R. C. Gonzalez, R. E. Woods & Steven Eddins, Pearson education, 2nd Edition, 2017.
3. Feature Extraction and Image Processing for Computer Vision by Alberto S. Aguado and Mark S. Nixon, Academic Press, 3rd Edition, 2012.
4. Image Processing, Analysis and Machine vision by Milan Sonka, Roger Boyle, and Vaclav Hlavac, Cengage India Private Limited, 4th Edition, 2017.

V Semester
Department of Electronics Engineering

Course Code : ENP 355-3 **Course : Digital Image Processing Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Apply mathematical tools to obtain basic features from an image and summarize image formation process through mathematical modelling.
2. Implement basic image processing algorithms for image enhancement and restoration.
3. Examine segmentation methods on image into its constituent regions and objects to extract the features from the image.
4. Evaluate modern methods of image processing and fundamentals of color image processing.
5. Formulate image compression algorithms using basic coding techniques.

Syllabus

Experiments based on ENT 355-3 Syllabus in Digital Image Processing

V Semester
Department of Electronics Engineering

Course Code : ENT355-4 **Course : Object Oriented Programming Using Python**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Use of the Python programming language in the development of small to medium-sized application programs.
2. Understand the principles of object-oriented programming; create classes, instantiate objects and invoke methods.
3. Understand concept of generics and implement collection classes. Use exception handling mechanism.

Demonstrate an introductory understanding of graphical user interfaces

Syllabus

Module I: (6Hrs)

Introduction to Python: Data types, Variables, Operators, Control structures including selection, Looping, String Class, Math class, Arrays in Python.

Module II: (10Hrs)

Features of Object-Oriented Programming: Objects and classes, attributes and behaviors, basic and multiple Inheritances, organizing modules, abstract base classes.

Exceptions: Exceptions, types of exception, exception hierarchy, handling multiple exceptions, user define exceptions.

Module III: (7Hrs)

Data structures: Empty objects, tuples, data classes, using default dict, Lists, sets, Extending built in functions.

Object orientation shortcuts: built-in functions, len (), reversed, enumerate, method overloading, default, variable, unpacking arguments, Using function as attribute, callable objects.

Module IV: (6Hrs)

Strings and Serialization: Manipulation and Formatting strings,escaping braces, f-strings, custom formatters, Unicode, mutable byte strings, matching patterns, regular expressions, file system paths, serializing objects, customizing pickles, serializing web objects.

Module V: (6Hrs)

Testing: Test driven development, testing with pytest, Imitating expensive objects.

Event and GUI programming: Event Driven programming, tkinter basic, Layout options, Custom events.

Text Books

1. Python 3 Object-Oriented Programming by Dusty Phillips, Packt publication, 3rd Edition.
2. Object-Oriented Programming in Python by Michael H. Goldwasser, Prentice Hall, 1st Edition.3. Programming Python: Powerful Object-Oriented Programming by Mark Lutz, Shroff, 4th Edition.

Reference Books

1. Mastering Object-Oriented Python by Steven F. Lott, Pack publication, 2nd Edition.
2. Programming with Python by T R Padmanabhan, Springer, 1st Edition.

V Semester
Department of Electronics Engineering

Course Code : ENP355-4 **Course : Object Oriented Programming using Python Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Use of the Python programming language in the development of small to medium-sized application programs.
2. Understand the principles of object-oriented programming; create classes, instantiate objects and invoke methods.
3. Understand concept of generics and implement collection classes. Use exception handling mechanism.
4. Demonstrate an introductory understanding of graphical user interfaces

Syllabus

Experiments based on ENT 355-4 Syllabus in Python.

V Semester
Department of Electronics Engineering

Course Code : HUT351 | **Course : Professional Skill Development**

L: 02 Hrs, T: 00 Hr., Per Week | **Total Credits : 0**

Course Outcomes

At the end of this course students will develop the ability to

CO 1 : Students will learn the importance and skills of verbal and non-verbal communication in a professional setting

CO 2 : Students will learn and apply the skill to write effective professional / workplace documents.

CO 3 : Students will learn the generic skills required to work in a team.

Syllabus

Unit 1 : Verbal and non-verbal skills

Verbal : Presentation and public speaking skills, Skills to conduct a meeting, PAC concept in communication.

Non-verbal : Body Language, Kinesics, Proxemics, Haptic, Paralinguistic, Chromatic, Chronomatic, Dress sense.

Unit 2 : Writing Skills

Grammar for effective writing : Tighten word sentences, repair sentence fragments, subject-verb agreement, Pronoun and antecedent agreement, tense and voice.

Email and letter Writing : Basic format, types.

Report writing : Basic format, Progress, project report, business proposal.

Organizational communication : Notices, circulars, minutes of the meeting.

Technology enabled communication : Text messaging, Podcast, Videoconferencing, and Social media in professional settings.

Unit 3 : Generic Skills

Leadership Skills, Innovation and creativity, Problem-solving skills, Decision-making, Time-management.

Text/Reference books

1. Shalini Varma (2015), Business Communication : Essential Strategies for 21st Century Managers, Vikas Publishing House.
2. P. D. Chaturvedi and Mukesh Chaturvedi (2018) The Art and Science of Business Communication: Skills, concepts, cases, and Applications, Pearson India Education Services Pvt. Ltd.
3. E. H. MacGrath, S. J. (2016) Basic Managerial Skills for All, PHI Learning Pvt. Ltd.
4. Diana Hacker (2019) Rules for Writers, Bedford Books, St. Martin's Press, 9th Edition.

VI Semester
Department of Electronics Engineering

Course Code : MBT 351 **Course : Business Management and Entrepreneurship**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Understanding of the evolution of management, its history and the development of important concepts.
2. Exposure to the practice of management in contemporary organization
3. Ability to analyze and understand management as well as exploring and developing their own personal philosophy of management.
4. To provide an introduction to entrepreneurship and its development process.
5. To provide understanding about various sources of finances and business expansion.
6. To provide conceptual clarification of networking, e-business and growth strategies.

Syllabus

Module I: (5 Hours)

Introduction to Business Management: Nature – Function – Definition – Importance of Management – Scope of Management – Is management a science or art? – Management Functions and skills – Development of Management Thought (Contribution of Taylor, Fayol, Hawthorne experiments).

Module II: (5 Hours)

Planning: Concept – Nature – Importance – Types of Planning – Strategic and Operational Plans (Policy, Procedures, Methods, Rules, Budget, Mission, Objectives), Planning Premises.

Module III: (6 Hours)

Organizing: Concept – Principles involved – Types of organization structure - Combining Jobs: Departmentation, Span of Control, Delegation of Authority.

Decision Making: Concept – Types - Steps involved– methods of decision making – Committee Decision Making.

Module IV: (7 Hours)

Entrepreneurship – Meaning, Types, Qualities of an Entrepreneur, Classification of Entrepreneurs, Factors influencing Entrepreneurship, Entrepreneurship Development Programmes (EDP), Business Idea: Sources & Evaluation .

Module V: (6 Hours)

Entrepreneurial Finance: Debt, Venture Capital, Buying a Business: challenges, The Search, Process, Scrutiny, Valuation, Negotiation, Franchising, Commercial Banks.

Module VI: (6 Hours)

Entrepreneurship E-Business, Networking: Starting & Managing a Network, Infrastructure, Best Practices, Growth Strategies: Stages of Growth, Global Expansion, Relocation, Financing Growth, Business Cases

Text Books

1. Principles and Practice of Management: L M Prasad, Sultan Chand & Sons educational.
2. Entrepreneurship: Rajeev Roy, Oxford Publication.

Reference Books

1. Management Theory and Practice: P SubbaRao, Himalaya Publishing House
2. Principles of Management: Dr. NeeruVasishth, Taxmann's Publication
3. Management Principles, Processes and Practices: Anil Bhat&Arya Kumar, Oxford Publications
4. Vasanta Desai: Dynamics of entrepreneurial development and management, Himalaya Publishing House
5. Innovation and development: Peter F. Drucker.

VI Semester
Department of Electronics Engineering

Course Code : ENT357 **Course : Analog and Digital Communication**

L: 03 Hrs, T: 01 Hrs. Per Week **Total Credits : 4**

Course Outcomes

1. Understand and compare different analog modulation schemes for their efficiency and bandwidth
2. Describe and analyze pulsed communication systems
3. Apply knowledge of signals and systems and analyze the performance of digital communication systems in presence of noise
4. Design as well as conduct experiments to analyze analog, digital modulators and demodulators using hardware components and simulation tools

Syllabus

Module - I : (8 Hrs)

Review of signals and systems & Amplitude Modulation Techniques : Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Noise in amplitude modulation systems, AM Superheterodyne receiver

Module - II : (10 Hrs)

Angle Modulation Techniques : Representation of FM and PM signals, Spectral characteristics of angle modulated signals. Noise in Frequency modulation systems, Pre- emphasis and De- emphasis, Threshold effect in angle modulation, FM Superheterodyne receiver.

Module - III : (7 Hrs)

Introduction to Information Theory & Pulse Modulation Techniques : Channel capacity theorem, Sampling Theorem, Pulse modulation techniques, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing

Module - IV : (10 Hrs)

Geometric Representation of signals & Digital Modulation Schemes : Gram Schmidt Orthogonalization, Inter symbol Interference, eye pattern, Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation.

Module - V : (10 Hrs)

Performance Analysis of Digital Communication Systems : Optimum demodulation of digital signals over band-limited channels, Maximum Likelihood sequence detection (Viterbi Receiver), Synchronization and Carrier Recovery for Digital Modulation.

Text Book

1. Lathi B. P. and Ding Zhi, "Modern Analog and Digital Communication Systems", Oxford University Press, Fourth Edition, 2011

Reference Books

1. Haykin S. and Moher M., "Introduction to Analog and Digital Communications", John Wiley & Sons, Second Edition, 2012.
2. Haykin S., "Communication Systems", John Wiley & Sons, Fourth Edition, 2006.
3. Tomasi W., "Electronic Communications System: Fundamentals Through Advanced", Pearson Education, Fifth Edition, 2008.

VI Semester
Department of Electronics Engineering

Course Code : ENP357 **Course : Analog and Digital Communication Lab**

L: 02Hrs, Per week **Total Credits : 1**

Course Outcomes

1. Understand and compare different analog modulation schemes for their efficiency and bandwidth
2. Describe and analyze pulsed communication systems
3. Apply knowledge of signals and systems and analyze the performance of digital communication systems in presence of noise
4. Design as well as conduct experiments to analyze analog, digital modulators and demodulators using hardware components and simulation tools

Syllabus

Experiments based on ENT 357 Syllabus in Analog and Digital Communication

VI Semester
Department of Electronics Engineering

Course Code : ENT 358 **Course : Probability Theory and Stochastic Processes**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.
2. Comprehend the interrelationship between discrete and continuous random variables and characterize probability models and function of random variables.
3. Apply the fundamentals of probability theory, the concept of random variables and stochastic processes to solve practical engineering problems in Signal processing, information and communication technology.

Syllabus

Module I: (6 Hrs)

Fundamentals of Probability Theory: Review of sets, fields and events, axioms of probability, probability space, conditional probability, independence, Bayes' theorem and applications; Repeated trials, Bernoulli trials; the Binomial Law, the Poisson Law.

Module II: (6 Hrs)

Random Variable: Definition of a Random Variable, Continuous, Discrete, and Mixed Random Variables, probability mass function, Common probability distribution and density functions; examples of common random variables and density functions; Conditional and Joint Distributions and Densities.

Module III: (6 Hrs)

Functions of random variables: Functions of one and two random variables, Expectation, Moments, and characteristic functions of random variables, mean, variance, Covariance, correlation coefficient, conditional expectation, Joint Moments.

Module IV: (5 Hrs)

Probability and Moment Approximations Using Limit Theorems: Strong and weak laws of large numbers, Central Limit Theorem. Markov, Chebyshev and Schwarz Inequalities, Chernoff bounds.

Module V: (4 Hrs)

Random sequences: Sequences of random variables, Mean square estimation, Stochastic Convergence, Parameter Estimation and Hypothesis Testing.

Module VI: (8 Hrs)

Stochastic Processes: Definition, Classification and properties of stochastic processes, strict and wide sense stationary processes; Ergodicity, ergodic processes; bandlimited and periodic processes; random processes and linear systems; noise processes; Wiener filtering; examples of random processes, Bernoulli process, Poisson process, Markov Chains, Markov process.Mean and covariance functions, Ergodicity, Transmission of random process through LTI, Power spectral density.

Text Books

1. Probability, Random Variables and Stochastic Processes by Athanasios Papoulis and S. Unnikrishnan Pillai, Tata McGraw-Hill, 4th Edition, 2002.
1. Statistics, and Random Processes for Engineers by H. Stark & J. W. Woods, Probability, Pearson, 4th Edition, 2012.

Reference Books

1. Probability and Stochastic Processes. A Friendly Introduction for Electrical and Computer Engineers by R. D. Yates & D. J. Goodman, Wiley, 3rd Edition, 2014.
2. Probability in Electrical Engineering and Computer Science: An Application-Driven Course by Walrand, J., Quorum Books (2014).
3. Introduction to Probability Models by Sheldon M. Ross, Academic Press, 10th Edition 2009.
4. Elementary Probability Theory with Stochastic Processes by K. L. Chung, Springer International Student Edition, 3rd Edition, 1979.
5. Intuitive Probability and Random Processes by S. Kay, Springer, 1st Edition, 2006.
6. Statistics, and random processes for electrical engineering by Alberto Leon-Garcia, Probability, Pearson education, 3rd Edition, 2007.
7. Probability and Random Processes with applications to Signal Processing and Communications by Scott L. Miller, D. Childers, Academic Press, 2nd Edition, 2012.

VI Semester
Department of Electronics Engineering

Course Code : ENP359 **Course : Electronic Design workshop**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Identify, understand, formulate, and solve engineering problems.
2. Apply knowledge of math, science, and engineering.
3. Function in multi disciplinary teams.
4. Engage in Life-long learning.
5. Design and develop a system or process.
6. Employ techniques, skills, and modern engineering tools for presentation, report / paper drafting, and product manual development.

Syllabus

The lab contents are based on development of mini product(s) by employing the knowledge gained in other semesters. This practical mainly focuses on electronic product development cycle and its stepwise implementation. The skills required to write a quality research articles/project report/product manual development./patent and presentation are also developed through various technical sessions, seminars, You Tube Lectures, NPTEL / EDX / COURSERA online courses and assessments.

VI Semester
Department of Electronics Engineering

Course Code : ENT 360 **Course : Computer Architecture And Organization**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

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

Syllabus

Module I: (4 Hrs)

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

Module II: (6 Hrs)

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

Module III: (7 Hrs)

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

Module IV: (7 Hrs)

Motivation for Pipelining, Clock period and CPI, Pipelined datapath, graphical representation, Pipelining Hazards.

Module V: (7 Hrs)

Memory organization, concepts of semiconductor memory, memory management, concept of Cache and associative memories, virtual memory.

Module VI: (4 Hrs)

Parallel processing concepts, multiprocessors and its characteristics. Input/ Output Subsystem:- Interfaces and buses, I/O Operations, Designing I/O Systems.

Text Books

1. David A. Patterson, Computer Organization and Design - The Hardware/Software Interface, 5th Edition, John L. Hennessy, Morgan Kaufmann Publications, 2014.
2. William Stallings, Computer Organization and Architecture: Design for Performance, 10th Edition, PHI, 2016.

Reference Books

1. J. P. Hayes, Computer Architecture and Organization, 3rd Edition, (Fifth Reprint), McGraw Hill, 2012.2. Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill, 2012.
3. Safwat G. Zaky, Zvonko G. Vranesic, Carl Hamacher, Computer Organization, 5th Edition, McGraw Hill, 2002.
4. Andrew. S. Tanenbum, Structured Computer Organization, 5th Edition, Pearson, 2005.

VI Semester
Department of Electronics Engineering

Course Code : ENP360 **Course : Computer Architecture and Organization lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

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

Syllabus

Experiments based on ENT360 Syllabus.

VI Semester
Department of Electronics Engineering

Course Code : ENT361-1 **Course : Designing the Internet of Things**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Learn the working Internet of Things.
2. Know about the computer networks and protocols.
3. Understand the wireless technologies used in IoT.
4. Design an IoT based system.
5. Demonstrate an IoT application

Syllabus

Module - I : (6Hrs) : Introduction to IOT: Equation of IOT, Applications of IOT, Enchanted objects, Affordances, IoT conceptual framework, Machine to Machine (M2M) communication.

Module - II : (6Hrs) : Computer networks : The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, MAC Addresses, Application Layer Protocols, MQ Telemetry Transport (MQTT) protocol.

Module - III : (6Hrs) : IoT wireless technologies : WiFi, Bluetooth, Zig-bee, RFID, Cellular (3G/4G/5G)

Module - IV : (6 Hrs) : Hardware prototyping : Arduino IDE, Arduino functions, Arduino C, Interfacing sensors and actuators, Serial protocols (UART, I2C, SPI), hands-on projects

Module - V : (6Hrs) : Introduction to ESP8266 based development board : Programming ESP8266 through Arduino IDE, connecting to the internet, sending and receiving data on the internet, interfacing sensors and actuators, hands-on projects

Module - VI : (5Hrs) : Case studies : Applications of IoT in Homes, Healthcare, Education, Agriculture, Energy, Manufacturing, Logistics, etc.

Text Books

1. Designing the Internet of Things by Adrian McEwen and Hakim Cassimally, John Wiley and Sons, Ltd., 1st Edition.
2. Internet of Things, Architecture and Design principles by Raj Kamal, McGraw Hill education (India) Pvt. Ltd. 1st Edition

Reference Books

1. Learning of Internet of Things by Peter Waher, Packt Publishing, 1st Edition.
2. Computer Networking: A top down Approach; James F. Kurose , Keith W. Ross; Pearson Education, 5th edition.

VI Semester
Department of Electronics Engineering

Course Code : ENP361-1 **Course : Designing the Internet of Things Lab**

L: 0 Hrs, T: 0 Hrs., P: 02 Hrs Per Week **Total Credits : 01**

Course Outcomes

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

1. Learn the working Internet of Things.
2. Know about the computer networks and protocols.
3. Understand the wireless technologies used in IoT.
4. Design an IoT based system.
5. Demonstrate an IoT application

Syllabus

Experiments based on ENT361-1 syllabus are in C language.

VI Semester
Department of Electronics Engineering

Course Code : ENT 361-2 **Course : Microwave Theory & Techniques**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes:

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

1. Understand the various microwave system components and their properties.
2. Analyse planar transmission line with the help of Smith chart.
3. Assemble/Create the microwave test bench to validate different measurement techniques.

Syllabus

Module I: (7Hrs)

Planar transmission lines: types, Introduction to micro strip lines, characteristic impedance, losses in micro strip lines. Impedance transformation and matching: matching with lumped elements-analytic and Smith chart solutions, the quarter wave transformer.

Module II: (8 Hrs)

Microwave network Analysis: Introduction to S-matrix, properties of S-parameters, S- parameters for a two-port junction with series and shunt elements. S-parameters of tee junctions, attenuators, matched termination, directional couplers, circulators, isolators, phase shifter.

Module III: (8 Hrs)

Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator.

Microwave active components: Diodes, Transistors, Oscillators, Filter, Power Amplifier, Low Noise Amplifier, Microwave Mixer.

Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes.

Microwave Tubes: Klystron, TWT, Magnetron.

Module IV: (6 Hrs)

Microwave measurements: Microwave Test Bench, measurement of VSWR, frequency, power, insertion loss, impedance measurement, the vector network analyser. Directivity, beam width, radiation pattern and gain measurement of microwave antennas.

Module V: (6 Hrs)

Microwave systems: Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Text Books

1. Microwave Engineering by David M. Pozar, Wiley India, 4th Edition, 2012.
2. Microwave Devices and Circuits by Samuel Y. Liao, Pearson Education, 3rd Edition, 2003.

Reference Books

1. Microwave Solid state Circuit Design, by I.J.Bahl & P.Bhartia, Wiley, 2003.
2. Foundations for Microwave Engineering by R.E.Collin, IEEE Press 2nd Edition, 2016.
3. Microwave Engineering by Annapurna Das and S.K.Das, Tata McGraw Hill, 2nd Edition, 2008.

VI Semester
Department of Electronics Engineering

Course Code : ENP 361-2 **Course : Microwave Theory and Techniques Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Understand the various microwave system components and their properties.
2. Analyse planar transmission line with the help of Smith chart.
3. Assemble/Create the microwave test bench to validate different measurement techniques.

Syllabus

Experiments based on ENT 361-2syllabus

VI Semester
Department of Electronics Engineering

Course Code : ENT 361-3 | **Course : Machine Learning**

L: 03 Hrs, T: 00 Hr., Per Week | **Total Credits : 3**

Course Outcomes

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

1. Understand the fundamental concepts, and challenges of machine learning: data, model selection, model complexity, etc. and its applications to solve real-world problems.
2. Understand the concept of deep neural network and explore deep learning technique for solving real-world problems in various domains.
3. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
4. Design and implement machine learning solutions to classification, regression, and clustering problemswith Python programming language and test them with benchmark data sets.

Syllabus

Module I: (5 Hrs)

Introduction to machine learning, the concept learning task, Inductive Learning Bias, FIND-S and Candidate-Elimination algorithm, Decision Trees, Basic decision trees learning algorithm, inductive bias in decision tree learning, over fitting.

Module II: (6 Hrs)

Supervised learning algorithms: Linear and Logistic Regression – Bias/Variance Trade-off, Regularization, Variants of Gradient Descent, Support Vector Machines, Kernel functions in SVM, K-Nearest Neighbors, and Applications.

Module III: (7 Hrs)

Artificial Neural Networks, Perceptron, Multilayer networks and Backpropagation algorithm, Introduction to Deep Neural networks, Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs).

Module IV: (6 Hrs)

Probabilistic Machine Learning- Bayesian learning and Bayesian networks, Gibbs algorithm, Naive Bayes classifier; Bayes optimal classifiers, Maximum Likelihood Estimation, MAP; Gaussian Discriminant Analysis.

Module V: (6 Hrs)

Unsupervised learning algorithms: Instance based learning, K-Means clustering, Expectation Maximization, and Gaussian Mixture Models. Dimensionality Reduction-PCA, LDA, and Feature Selection, PAC Learnability, Reinforcement Learning, Multi-class Classification.

Module VI: (5 Hrs)

Applications of machine learning to Information Retrieval, Computer Vision, Natural Language Processing, and applications on the web.

Text Books

1. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, Francis Bach, MIT Press, 2012.
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, First edition, Springer, 2006.

Reference Books

1. The Elements of Statistical Learning Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2nd Edition, Springer, 2009.
2. Machine Learning by Mitchell Tom 1st Edition, McGraw Hill, 1997.
3. Deep Learning by Ian Good fellow, Yoshua Bengio, Aaron Courville & Francis Bach, MIT Press, 2017.
4. Introduction to Machine Learning by Ethem Alpaydin, 3rd Edition, PHI Learning, 2015.
5. Machine Learning: An Algorithmic Perspective by Stephen Marsland, Second Edition, Chapman
6. And Hall/CRC, 2014.
7. Understanding Machine Learning: From Theory to Algorithms by Shalev-Shwartz, Shai Ben-David, 3rd Edition, Cambridge University Press, 2015.
8. Pattern classification by Richard O. Duda, Peter E. Hart, David G. Stork. Wiley, New York, 2001.

VI Semester
Department of Electronics Engineering

Course Code : ENP 361-3 **Course : Machine Learning Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

1. Understand the fundamental concepts, and challenges of machine learning: data, model selection, model complexity, etc. and its applications to solve real-world problems.
2. Understand the concept of deep neural network and explore deep learning technique for solving real-world problems in various domains.
3. Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
4. Design and implement machine learning solutions to classification, regression, and clustering problems with Python programming language and test them with benchmark data sets.

Syllabus

Experiments based on ENT 361-3 Syllabus in Machine Learning.

VI Semester
Department of Electronics Engineering

Course Code : ENT361-4 **Course : Database Management System**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

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

Syllabus

Module I: (5 Hrs)

Overview of Database Systems: Basic Concepts Database & Database Users, File System vs. DBMS, Database Systems Concepts & Architecture, Date Models, Schemas & Instances, Structure of Relational Databases, The Relational Algebra-Fundamental operators and syntax, Extended Relational Algebra Operations.

Module II: (7 Hrs)

Entity-Relational Model: Basic Concepts, Constraints, Keys, Design Issues, Entity- Relationship Diagram, Weak Entity Sets, Extended E-R Features, Design of an E-R Features, Transforming ER Model to Relational Data Model.

Module III: (7 Hrs)

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

Module IV: (6 Hrs)

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

Module V: (6 Hrs)

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

Module VI: (4 Hrs)

Introduction to Advances in Databases: Object-Oriented Databases, Web Databases, Data Warehousing and Mining, Parallel Databases, Distributed Databases.

Text Books

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth and S. Sudarshan, McGraw Hill Education, 6th Edition, 2013.2. Database Management Systems by Raghu Ramkrishnan and Johannes Gehrke, McGraw Hill Education, 3rd Edition, 2014.
3. SQL, PL/SQL the Programming Language of Oracle by Ivan Bayross, BPB publications, 4th Edition, 2017.

Reference books

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

VI Semester
Department of Electronics Engineering

Course Code : ENP 361-4 **Course : Database Management System Lab**

L: 00Hrs, T: 00 Hr., P: 02 Hrs Per week **Total Credits : 1**

Course Outcomes

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

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

Syllabus

Experiments based on ENT 361-4 Syllabus in Database Management System

VII Semester
Department of Electronics Engineering

Course Code : ENT451 **Course : Computers Networks**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

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

Syllabus

Module - I : (5 Hrs)

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

Module - II : (7Hrs)

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

Module - III : (5 Hrs)

Transport Layer Services, Transport layer protocols, UDP & TCP, Congestion control,

Module - IV : (8 Hrs)

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

Module - V : (5 Hrs)

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

Module - VI : (5 Hrs)

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

Text Books

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

Reference Books

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

VII Semester
Department of Electronics Engineering

Course Code : ENP451 **Course : Computers Networks Lab**

L: 0Hrs, T: 0Hr., P: 2Hrs Per week **Total Credits : 1**

Course Outcomes

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

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

VII Semester
Department of Electronics Engineering

Course Code : ENT452-1 | **Course : Digital System Design**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week | **Total Credits : 3**

Course Outcomes

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

1. Understand the system design flow for FPGA
2. Apply the knowledge in the process of system design
3. Design the building blocks of digital systems
4. Analyse the performance of the digital systems
5. Create the new systems to solve the real world problems

Syllabus

Module - I : (5 Hrs)

HDL Language Fundamentals and FPGA design flow: Overview of HDL, FPGA architecture and resources, FPGA Design flow, Design methodologies

Module - II : (10 Hrs)

Case studies: Case studies on Modelling , Simulation and Synthesis of Combinational and Sequential Building blocks in FPGA

Module - III : (8 Hrs)

Overview of Back end Processes: Logic partitioning, floor planning, and placement, routing, high-level synthesis, and partial run-time reconfiguration

Module - IV : (12 Hrs)

Performance Analysis and improvement techniques: Timing Analysis, logic Synthesis and Optimization techniques for the area, speed, and power, Synthesis of HDL code on FPGA platforms, Clock Tree Synthesis

Text Books

1. Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar; Pearson Education; 2nd edition
2. Digital System Design Using VHDL: Jr. Roth Charles H.; Cengage Learning

Reference Books

1. Digital System Design with FPGA Implementation Using Verilog and VHDL; Cem Unsalan, Yeditepe University, Istanbul, Turkey Bora Tar ; McGraw Hill India.

VII Semester
Department of Electronics Engineering

Course Code : ENT452-2 **Course : Wireless Communication**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Understand the working principles of the wireless communication systems.
2. Use the various techniques to improve the performance of wireless communication systems.
3. Analyze wireless communication systems for improved performance.

Syllabus

Module - I : (6 Hours)

Cellular concepts : Evolution of Mobile radio communication. Cellular telephone system, frequency reuse, channel assignment and handoff strategies, Interference and system capacity, trunking and grade of service, improving capacity in cellular system.

Module - II : (5 hours)

Mobile radio propagation : free space propagation, propagation mechanism- reflection, refraction, diffraction and scattering, practical link budget design.

Fading channels : multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Module - III : (6 Hours)

Modulation techniques for mobile communication : Linear Modulation techniques- BPSK, QPSK and variants, QAM, GMSK (Gaussian Minimum Shift Keying), Spread spectrum modulation technique, multicarrier modulation and OFDM.

Module - IV : (6 Hours)

Equalization & diversity : Fundamentals of equalization, space polarization, frequency and time diversity techniques, Space diversity, polarization diversity, fundamentals of channel coding.

Module - V : (6 Hours)

Multiple access techniques : Introduction to Multiple Access, FDMA, TDMA, Spread spectrum multiple access, frequency hopped multiple access (FHMA), Code division multiple access (CDMA), Space division multiple access (SDMA).

Module - VI : (6 Hours)

Introduction to Wireless systems : GSM, GPRS, WCDMA, MIMO - service and features, system architecture, radio subsystem, channel types, LTE.

Text Books

1. Wireless Communication, Principles and Practice; T.S. Rappaport, Pearson Education, 2nd Edition.

Reference Book

1. Wireless and Digital Communications; Modulation and Spectrum Applications Kamilo Feher, PHI, 1st Edition.
2. Mobile Cellular Communications, William C. Y. Lee, McGraw Hill, 2nd Edition.
3. Mobile Communication, Jochen Schiller, 2nd Edition, Adsison Wesley, 2nd Edition.
4. GSM, GPRS, and EDGE Performance: Evolution Towards 3G UMTS, Timo Halonen, Javier Romero, Juan, Malero, Wiley, 2nd addition
5. Mobile Communication Design Fundaments, William C. Y. Lee, John Willey & Sons, 2nd Edition.
6. Fundamentals of Wireless Communication, David Tse and P. Viswanath, Cambridge University Press, 2005, 1st Edition.

VII Semester
Department of Electronics Engineering

Course Code : ENT452-3 **Course : Analog IC Design**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Understand the behavior of MOS Devices and Small-Signal Modeling of MOS Transistor
2. Understand basics of data converters
3. Apply mathematical models of MOS transistors to evaluate their behavior in analog circuits.
4. Select suitable design approaches while trading off conflicting requirements.
5. Investigate various analog IC performance parameters

Syllabus

Module - I : (7 Hrs)

Basic MOS models for Analog Design, SPICE Models and Overview of noise in analog circuits.

Module - II : (5 Hrs)

Basic Building Blocks for IC : Switches. Current sources and sinks, Current mirrors, Voltage references, Layout Considerations

Module - III : (8 Hrs)

Amplifiers : MOS amplifiers, Common Source, Source follower, Common Gate, Cascode amplifiers, Level shifter, Output stage Class AB and Push-Pull amplifier. Frequency response and stability considerations

Module - IV : (7 Hrs)

Differential Amplifier : Basic differential Pair, common mode response, Differential Pair with MOS loads.

Module - V : (6 Hrs)

Design of CMOS Op-Amps, one-stage OPAMP, Two Stage OP-Amps, Compensation of Op-Amps.

Module - VI : (7 Hrs)

Data Converter fundamentals. DAC, ADC specifications.. R-2R ladder, charge scaling, cyclic and pipelined DACs. Flash, pipeline, SAR, Integrating and Sigma Delta ADCs

Text Books

1. Design of Analog CMOS IC: B Razavi, Tata Mcgrw Hill, (2002)
2. CMOS Analog Circuit Design: P.E. Allen ,D. R. Holberg, OUP, (3/E) (2012)

Reference Books

1. VLSI Design techniques for Analog and digital Circuits: Randel Geiger, P Allen, N Strader, TataMcgraw Hill, (2/E) (2010)
2. Analysis And Design Of Analog ICs : Paul R. Gray, Paul J. Hurst Stephen H. Lewis, Robert G. Meyer, J Willy and Sons, (4/E) (2001)
3. CMOS Circuit Design, Layout and simulation: : R. J. Baker, Wiley,(4/E),(2019)

VII Semester
Department of Electronics Engineering

Course Code : ENT453-1 **Course : Testing and Verification of Digital System**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. understand the concepts of testing of digital systems
2. to generate the test pattern for a specified fault
3. apply the knowledge of boundary scan standards
4. understand the basic concepts in temporal logic
5. construct the Binary Decision Diagrams(BDD)
6. understand the model checking algorithm

Syllabus

Module - I : (5 Hrs)

Introduction to Digital Testing : Introduction to Digital VLSI Testing, Functional and Structural Testing, Fault Equivalence, Fault Simulation, Testability Measures (SCOAP).

Module - II : (6 Hrs)

Combinational Circuit Test Pattern Generation : Introduction to Automatic Test Pattern Generation (ATPG) and ATPG Algebras, D Algorithm.

Module - III : (6 Hrs)

Design for testability and Built in Self-Test (BIST) : Scan Chain based Sequential Circuit Testing, Test interface and boundary scan, BIST architecture

Module - IV : (6 Hrs)

Memory Testing : Memory fault models, Stuck at fault, Transition Fault, Coupling Fault, In version Coupling Fault, Idempotent Coupling Faults, Address Decoder Faults, Neighborhood Pattern Sensitive fault, Memory testing Algorithms.

Module - V : (6 Hrs)

Temporal Logic : Introduction to formal methods for verification, Introduction and Basic Operators, Syntax and Semantics of CTL, Equivalence between CTL Formulas

Binary Decision Diagram : Introduction and construction, Ordered Binary Decision Diagram, Operations on Ordered Binary Decision Diagram, Ordered Binary Decision Diagram for Sequential Circuits

Module - VI : (6 Hrs)

Verification Techniques : Introduction to Verification Techniques, Model Checking algorithms, Symbolic Model Checking.

Text Book

1. Bushnell and Agrawal, Essentials of Electronic Testing for Digital, Memory &Mixed-Signal Circuits, Kluwer Academic Publishers, 2000
2. T. Kropf, Introduction to Formal Hardware Verification: Springer Verlag, 2000
3. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures: Design for Testability: Elsevier 2006

Reference Book

1. System-on-a-Chip Verification-Methodology and Techniques: P. Rashinkar, Paterson and L. Singh, Kluwer Academic Publishers, 2001
2. M. Huth and M. Ryan, Logic in Computer Science modeling and reasoning about systems, Cambridge University Press, 2nd Edition, 2004.
3. Digital Systems Testing and Testable Design: M. Abramovici, M. A. Breuer and A. D. Friedman, IEEE Press, 1990.

VII Semester
Department of Electronics Engineering

Course Code : ENT453-2 **Course : Fiber Optics Communication**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Understand light propagation using ray and wave theory in optical fibers.
2. Comprehend the elements of optical fiber link & optical networks
3. Be acquainted with various fiber fabrication methods and active & passive optical components.
4. Apply knowledge of transmission characteristics for the analysis of various losses and its measurement.

Syllabus

Module - I : (6 Hours)

Overview of optical fiber communication

Basic optical communication system, Advantages of optical communication system, introduction to vector nature of light , propagation of light in dielectric waveguides, step index and graded index fibers, modes and power flow in fibers.

Module - II : (6 Hours)

Transmission characteristics of optical fibers and measurement techniques

Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion. Measurement Techniques: Optical time domain reflectometry (OTDR), Eye Diagram., Parameter measurements in Optical fiber: Attenuation, dispersion, Numerical aperture and Refractive Index.

Module - III : (6 Hours)

Optical sources and detectors

LED, LASER, PIN and Avalanche photo detector structures and properties.

Module - IV : (6 Hours)

Fiber couplers and connectors

Composition of Optical fiber cables, Fabrication techniques, fiber joints, splices and connectors, couplers, optical isolators and circulators

Module - V : (4 Hours)

Optical receivers and amplifiers

Erbium-Doped Fiber Amplifiers, Raman amplifier, Wideband optical amplifiers, Receiver structures: low impedance front end, high impedance front end, the transimpedance front end.Module IV: (4 Hours) Optical networks

Optical Networks : concepts, optical terminology, optical network node and switching elements, Fiber Distributed Data Interface (FDDI), Synchronous Optical Networking (SONET) and Synchronous Digital Hierarchy (SDH), Recent trends in optical communication

Text Books

1. Gerd Keiser, "Optical Fiber Communication" Mc Graw -Hill International, 4th Edition., 2010.
2. John M. Senior , "Optical Fiber Communication", Second Edition, Pearson Education, 2007.

References

1. Ramaswami, Sivarajan and Sasaki "Optical Networks", Morgan Kaufmann, 2009.
2. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.
3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

VII Semester
Department of Electronics Engineering

Course Code : ENT453-3 **Course : Micro-Electro Mechanical System**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Apply the principles behind the operation of MEMS devices
2. Choose a micromachining technique for a specific MEMS fabrication process
3. Understand recent advancements in the field of MEMS and devices

Syllabus

Module - I : (7 Hrs)

Introduction to MEMS : Benefits of Miniaturization, Types of MEMS: Optical MEMS, Bio- MEMS, RF-MEMS, Microfludics, Success Stories, Pressure sensor, Accelerometer, Micro-mirror TV Projector.

Module - II : (7 Hrs)

Microfabrication and Micromachining : Integrated Circuit Processes, Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA), MEMS Device fabrication using Bulk Micromachining.

Module - III : (7 Hrs)

Surface Micromachining : One or two sacrificial layer processes, Surface micromachining requirements, Device fabrication using Surface Micromachining example, Microcantilever fabrication.

Module - IV : (6 Hrs)

RF MEMS Devices : Capacitor, Inductor, Switches, and antennas, RF MEMS components in communications, space and defense applications.

Module - V : (7 Hrs)

Physical Micro sensors : Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor

Principles and Examples : Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors.

Module - VI : (6 Hrs)

Microactuators : Classification of microactuators, Electrostatic, Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

Text Books

1. Micro and Smart Systems: Ananthasuresh, G. K., Vinoy, K. J., Gopalakrishnan, S., Bhat, K. N., and Aatre, V. K., Wiley-India, New Delhi, (1/E) (2010).
2. RF MEMS and Their Applications: Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, (1/E) (2002).

Reference Books

1. Microsensors, MEMS and Smart Devices , Julian W. Gardner , Vijay K. Varadan, Osama O. Awadelkarim, Wiley, (1/E) (2001).
2. VLSI Technology, Sze S.M., Mc Graw Hill, (2/E).

VIII Semester
Department of Electronics Engineering

Course Code : ENT457-1 **Course : CMOS Subsystem Design**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

After completion of the course student will be able to:

1. Analyze interconnect and VLSI sub-systems.
2. Design VLSI sub-systems for given specifications.

Syllabus

Module - I : (6 Hrs)

Wires and Interconnect : Resistance, Capacitance, RC delay analysis, Cross-talk delay and noise effects, Repeaters, Logical Effort, Crosstalk control, reliability.

Module - II : (6 Hrs)

Synchronizers; Arbiters; Clock Synthesis; PLLs; Clock generation; Clock distribution; Synchronous Vs Asynchronous design, introduction to pipelined system/ALU.

Module - III : (6 Hrs)

Datapath Subsystems : Adders: Full Adder using a variety of Logics styles, bit-serial Adder, Ripple Carry Adder, Carry-skip Adder, Carry Look-ahead Adder, Brent-Kung Adder, Kogge-Stone Adder, Carry-Save Adder (multi-operand addition), etc. with power and speed trade-off

Module - IV : (6 Hrs)

Datapath Subsystems : Multipliers: Unsigned Array Multiplier, Booth Encoded Multiplier, Baugh-Wooley Multiplier, Wallace tree multiplier, etc. , comparators, shifter-registers, random number generator based on Linear Feedback Shift-Registers (LFSR).

Module - V : (5 Hrs)

Memory Array Subsystems : Register-file, Content-addressable memory, LIFO and FIFO SRAM design, Reliability; Power dissipation in Memories

Module - VI : (7 Hrs)

Special-purpose Subsystems : Packaging; power distribution; I/O pads, Emerging topics in VLSI.

Text Books

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits” Pearson Education, Second Edition.
2. Neil H. E. Weste, David. Harris and Ayan Banerjee,, “CMOS VLSI Design” -Pearson Education, Third Edition, 2004.

Reference Books

1. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits” TMH, Third Edition, 2003
2. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.
3. CMOS Circuit Design, Layout and simulation: : R. J. Baker, Wiley,(3/E),(2010)
4. IEEE Transactions on Very Large Scale Integration (VLSI) Systems.
5. IEEE Transactions on Computers.

VIII Semester
Department of Electronics Engineering

Course Code : ENT457-2 **Course : Information Theory and Coding**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

After completion of the course student will be able to:

1. Understand the fundamentals of information theory
2. Apply the knowledge of typical sequency and asymptotic property
3. Examine the concepts of data and voice recording
4. Evaluate techniques of error control coding
5. Apply the concepts of compression techniques
6. Examine audio and video coding standards

Syllabus

Module - I : (6 Hrs)

Information Theory Fundamentals : Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding – Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

Module - II : (6 Hrs)

Typical Sequency and Asymptotic Property : Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set

Module - III : (6 Hrs)

Data and Voice Coding : Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

Module - IV : (6 Hrs)

Error Control Coding : Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolution codes.

Module - V : (7 Hrs)

Compression Techniques : Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

Module - VI : (6 Hrs)

Audio and Video Coding : Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

Text Books

1. Simon Haykin, "Communication Systems", John Wiley and Sons, 4th Edition, 2001.
2. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002.

Reference Books

1. Mark Nelson, "Data Compression Book", BPB Publication 1992.
2. Watkinson J" Compression in Video and Audio", Focal Press, London, 1995

VIII Semester
Department of Electronics Engineering

Course Code : ENT457-3 **Course : Biomedical Signal Processing**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Prerequisite : Biological science, Signals and Systems, and Digital Signal Processing

Course Outcomes

After completion of the course student will be able to:

1. Understand the process of generation and characteristics of biomedical signals, and practical problems in objective analyses of biomedical signals.
2. Apply signal processing techniques for filtering, noise removal, cancellation of interference, and characterization of biomedical signals.
3. Analyze biomedical signals for the detection of events such as the QRS complex, heart sounds and murmurs, and the dicrotic notch.
4. Develop the appropriate model of biomedical signal to understand the nature of phenomena responsible for generating the signal.
5. Implement appropriate signal processing algorithms for practical problems involving biomedical signals and systems.

Syllabus

Module - I : (4 Hrs)

Biomedical signal origin & dynamics (ECG, EEG, EMG etc.), The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. Concurrent, coupled and correlated processes - illustration with case studies. Basics of ECG - Electrical Activity of the heart- ECG data acquisition, Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics.

Module - II : (7 Hrs)

Filtering for Removal of artifacts: Statistical Preliminaries, Time domain filtering, Frequency Domain Filtering, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Optimal Filtering: The Weiner Filter, Adaptive Filtering, Selecting Appropriate Filter

Module - III : (7 Hrs)

ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis, Event detection - case studies with ECG & EEG, Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection Correlation Analysis of EEG Signal, Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.

Module - IV : (8 Hrs)

Waveform Analysis : Illustrations of problem with case studies, Morphological Analysis of ECG, Correlation coefficient, The Minimum phase correspondent. length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor. Frequency-domain Analysis: Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniell's Spectral Estimator, Measures derived from PSD.

Module - V : (6 Hrs)

Neurological Signal processing : EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation.

Module - VI : (8 Hrs)

Modelling of Biomedical Systems : Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients. ARMA model, Sequential estimation of poles and zeros.

Text Book

1. Biomedical Signal Processing: Principles and techniques, D. C. Reddy, Tata McGraw Hill, New Delhi, 2012.
2. Biomedical Signal Analysis: A case Based Approach, R. M. Rangayyan, Wiley 2002.

Reference Books

1. Discrete-time Signal Processing, A. V. Oppenheim and R. W. Shafer, Prentice Hall, Englewood Cliffs, NJ, 1989.
2. Biomedical digital signal processing, Willis J. Tompkins, Prentice Hall India, 1995.
3. Bioelectrical Signal Processing in Cardiac & Neurological Applications, Sörnmo, Elsevier, 2005.
4. Biomedical Signal Processing and Signal Modeling, E. N. Bruce, Wiley, 2009.
5. Bio signal and Medical Image Processing, John L. Semmlow and Benjamin Griffel, CRC Press, Third Edition 3rd Edition, 2014.
6. Biomedical Signal Processing and Artificial Intelligence in Healthcare (Developments in Biomedical Engineering and Bioelectronics), Walid A. Zgallai (editor), Academic Press, Year: 2020
7. Signal Processing and Machine Learning for Biomedical Big Data, Ervin Sejdic, Tiago H. Falk, CRC Press; 1st edition (19 July 2018).
8. Research Papers published in peer revived Journals such as Journal of Biomedical Signal Processing and Control, Journal of Biomedical Engineering and Medical Devices.

VIII Semester
Department of Electronics Engineering

Course Code : ENT458-1 **Course : Nanoelectronics**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Show a deeper understanding of the relation between novel behaviour of nanoelectronic devices and quantum behaviour of matter at the nano scale as well as the breakdown of received scaling wisdom
2. Appreciate scaling issues and ideas behind nanoscale fabrication technologies
3. Understand the principles of devices such as tunneling diodes, single electron transistor, spintronic devices

Syllabus

Module - I : (6 Hrs) : Introduction to Nanoelectronics, The top –down Approch, The Bottom-up Approch, challenges

and future

Module - II : (8 Hrs) : Single –Electron and Few Electron phenomena and Devices: Tunnel junctions and applications of tunneling, Coulomb Blockade and the single electron Transistor, Other SET and FET structures

Module - III : (7 Hrs) : Many Electron Phenomena: Particle statistics and density of states Quantum Wells, Quantum Wires , Quantum Dots and nanoparticles.

Module - IV : (7 Hrs) : Fabrication Techniques for nanostructures

Module - V : (6 Hrs) : Carbon nanotube and Nanowires and applications

Module - VI : (6 Hrs) : Spintronics devices and applications

Text Books

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

Reference Books

1. Nanosystems, K.E. Drexler, Wiley (1992).
2. The Physics of Low-Dimensional Semiconductors, John H. Davies, "Cambridge University Press, " (1998).

VIII Semester
Department of Electronics Engineering

Course Code : ENT458-2 **Course : SoC Design**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

After completion of the course student will be able to:

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

Syllabus

Module - I : (6 Hrs)

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

Module - II : (6 Hrs)

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

Module - III : (6 Hrs)

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

Module - IV : (6 Hrs)

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

Module - V : (5 Hrs)

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

Module - VI : (7 Hrs)

MPSoCs: Requirements, Concepts, Architecture for embedded MPSoC, Techniques for designing MPSoCs, Performance and flexibility for MPSoCs design, Zynq Architecture Design of ARM Based SoC Testing

Text Book

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

Reference Books

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

VIII Semester
Department of Electronics Engineering

Course Code : ENT458-3 **Course : Power Electronics**

L: 3Hrs, T: 0Hr., P: 0Hrs Per week **Total Credits : 3**

Course Outcomes

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

1. Explain the construction and characteristics of Power semiconductor devices and fundamental of thyristor family.
2. Apply the knowledge of power electronic converters for speed control of DC motors and various applications in the field of power electronics
3. Analyze and evaluate the behavior of ac-to-dc converters, dc-to-dc converters and dc-to- ac converters

Syllabus

Module - I : (7 Hrs)

Characteristics of Semiconductor Power Devices : Thyristor, power MOSFET and IGBT.

Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concepts of fast recovery and schottky diodes as freewheeling and feedback diode.

Module - II : (7 Hrs)

Controlled Rectifiers : Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Module - III : (7 Hrs)

Choppers : Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Module - IV : (6 Hrs)

Single-phase inverters : Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Module - V : (6 Hrs)

Switching Power Supplies : Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Module - VI : (6 Hrs)

Applications : Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing ofUPS. Separately excited DC motor drive, P M Stepper motor Drive.

Text Books

1. Fundamentals of Power Electronics, Erickson and Maksimovic, 2001
2. Principles of Power Electronics, Kassakian, 1991
3. Power Electronics: Converters, Applications and Design, Mohan, Undeland and Robbins

Reference Books

1. M D Singh and K B Khanchandani, "Power electronics", TMH, New Delhi, 2nd ed., 2007.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2003.
3. Vedam Subramanyam, "Power Electronics – Devices, Converters and Applications", New Age International Publishers Pvt. Ltd., Bangalore, 2nd ed. 2006.
4. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 2012..
5. Ned Mohan, Undeland and Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
6. V.R.Moorthi, "Power Electronics", Oxford University press, 2005.
7. G..K. Dubey, S.R. Doradla, A. Joshi, and R.M.K. Sinha, "Thyristorised Power Controllers", New Age International Ltd. Publishers, 1986 (Reprint 2008).
8. P.T. Krein, "Elements of Power Electronics", Oxford University Press, 1998. 9. G..K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2nd ed. 2001.

IV / VI Semester (Open Electives)
Department of Electronics Engineering

Course Code : ENT299-1 / ENT 399-1 **Course : Industrial Automation**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes:

After successfully completing the course students will be able to

1. Understand process control, PLC architecture and interfacing
2. Develop PLC ladder logic for industrial applications
3. Design Automation systems for industrial applications

Syllabus

Module I: (5Hrs)

Process Control & Automation: Process control principles, Analog and Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Industrial revolutions

Module II: (5 Hrs)

Signal Conditioning and Transmitters: Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for sensors, Smart and Intelligent transmitters

Module III: (5 Hrs)

Controllers and Actuators: Mechanical switches, Solid-state switches, Electrical actuators: Solenoids, Relays and Contactors, AC Motor, DC Motors, Servo Motor, Pneumatic and hydraulic actuators.

Module IV:(8 Hrs)

PLC: Functions of PLC, Architecture, Selection of PLC, Networking of PLCs, Ladder Programming, Interfacing Input and Output devices with PLC, PLC based automated systems. High frequency inputs. PLC programming standard IEC61131

Module V: (6 Hrs)

SCADA & Distributed control system: Elements of SCADA, Features of SCADA, MTU, RTU Functions, Applications of SCADA, Communications in SCADA, Introduction to DCS, Architecture, Input and output modules, Specifications of DCS.

Module VI: (6 Hrs)

Industrial Communication : Device network: CAN, PROFIBUS-PA, Control network: ControlNet, PROFIBUS-DP, Ethernet, Interfaces: RFID, Barcode, Human Machine Interface : Block Diagram, Types, Advantages and industrial applications.

Text Book

1. Programmable Logic controllers and Industrial Automation: Madhu chhanda Mitra, Samarjit Sen Gupta, Penram International Publishing India Pvt. LtdReference Books:

1. Programmable Logic Controllers, Principles and Applications: John W. Webb, Ronold A Reis,5th Edition, Prentice Hall of India Pvt. Ltd.
2. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication
3. Process Control Instrumentation Technology: Curtis Johnson, 8th Edition, Pearson Education.

IV/VI Semester (Open Electives)
Department of Electronics Engineering

Course Code: : ENT 299-2/ ENT 399-2 **Course : Micro-Nano System**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits: 3**

Course Outcomes

After successfully completing, the course students will,

1. Gain knowledge of MEMS and its application in sensor and actuator
2. Nano material, and manufacturing of Nano electronic devices.
3. Understand various measuring techniques and tools.

Syllabus

Module I: (6Hrs)

Introduction to MEMS: Miniaturization, Types of beams and deflection of beams, Micromachining technology, Thin film deposition, sputtering methods, etching process.

Module II: (6 Hrs)

MEMS sensors and actuators: Piezoresistive sensing and actuation, Electrostatic sensors and actuators, Thermal sensing and actuation, Magnetic actuation, MEMS applications.

Module III: (6 Hrs)

Materials in Nano Electronics: Band structures in Silicon, Basics of crystal structure, defects, crystalgrowthand wafer fabrication, crystal planesand orientation. Modern CMOS technology

Module IV:(6 Hrs)

Semiconductor Nano Electronics: Wafer contaminations, Wafer cleaning methods, Lithography: basic concepts of optics, photoresists, wafer exposure systems, methods and equipment, Thermal Oxidation

Module V: (6 Hrs)

Nano Electronic Devices: Single Electron devices and Transistors, Quantum particle, Quantum Dot, Logic circuits using quantum dots, nano-wires construction and applications, Fin FETs, construction and properties

Module VI: (5 Hrs)

Measurements methods and tools: IV/CV characterization, Hot probe method, Sheet resistance, Physical measurements: Electron microscopy, Atomic Force Microscope, X-Ray photoelectron Spectroscopy, Profilometers

Text Books

1. Foundations of MEMS: Chang Liu, Pearson Education.
2. Fundamentals of Nanoelectronics: George W Hanson, Pearson education

Reference Books

1. NanoelectronicsDevices: Byung-Gook Park, Sung Woo Hwang, Young June Park,Pan Stanford Publishing Pte. Ltd.
2. Silicon VLSI Technology, Fundamentals, Practice and Modeling: James D Plummer, Michaeld Deal and Peter B Griffin, Pearson Education.
3. Nano Circuit Design: Niraj K. Jha, Deming Chen, Springer

IV / VI Semester
Department of Electronics Engineering

Course Code : ENT 299-3/ ENT 399-2 **Course : Designing with Raspberry Pi**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 3**

Course Outcomes

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

1. Wire Raspberry Pi and create a fully functional computer
2. Use Python-based IDE and trace and debug Python code on the device.
3. Measure physical parameter using sensors.
4. Implement various communication protocols for wired and wireless communication.
5. Interfaces different motors and create robots.

Syllabus

Module I: (6Hrs)

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

Module II: (6 Hrs)

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

Module III: (6 Hrs)

Programming the Raspberry Pi: Python: Introducing to Python programming language; Python Programming Environment, Python Expressions, Strings, Functions, Function Arguments, Lists, List Methods, Control Flow, Numpy, PIP (Python Installation Package) and customized libraries.

C++ programming: Basic C++ programming approach, header file structure and library organization, Cross Compiler and its configuration.

Module IV: (6 Hrs)

Exploring Electronics with the Raspberry Pi: Communication facilities on raspberry Pi (I2C, SPI, UART), working with RPil. GPIO library, Interfacing of Sensors and Actuators.

Project 2: Set UP a Pi motion detector Project 3: Set UP a Pi ADC/DAC

Project 4: CONSTRUCT a digital weather station

Project 5: CONSTRUCT a Traffic Light Controller

Module V: (6 Hrs)

Communication using Raspberry Pi: Wired and Wireless communication, TCP, IP configurations, SSH, Putty terminal usage.

Project 6: Set UP file serverProject 7: Network YOUR keyboard and MOUSE Project 8: Create a portable wireless access point Project 9: COMMUNICATE with ARDUINO

Project 10: CONSTRUCT a digital server based weather station

Module VI: (5 Hrs)

Robotic Motion PI: DC, Servo, Stepper, Motor Drivers, Motor Shields, Camera Interfacing, remote data logging.

Project11:KeyboardControlRobot Project 12: Wireless Robot

Text Books

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

V / VII Semester
Department of Electronics Engineering

Course Code : ENT 398-1/ ENT 498-1 **Course Name : Smart Agriculture**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

Upon completion of this course, Students will be in position to understand

1. Soil science, Plant anatomy and health monitoring
2. Sensors and actuators for farming tools, sensor data acquisition and telemetry
3. Advanced technologies for smart farming

Syllabus

Module I: (6 Hrs)

Soil Science: Nature and origin of soil; soil minerals, classification and composition, soil reaction, soil properties including structure, PH, surface tension and soil nutrient

Module II: (6 Hrs)

Sensors: Classification and characteristics, Smart sensors, Colorimetry based detection, MEMS Electrochemical Sensors, Dielectric Soil Moisture Sensors, ISFET, Weather sensors, Proximity Sensors, Signal conditioning and converters.

Module III: (6 Hrs)

Actuators for tool automation: A.C.-D.C. Motors, Stepper motor, Solenoid actuators, Piezoelectric motors, Electric drives, Hydraulic and Pneumatic actuator

Module IV: (6 Hrs)

Telemetry: Wireless communication modules and topology, Zig-bee, Bluetooth, LORA, Zero power devices, Energy Harvesting technology

Module V: (5 Hrs)

Plant health monitoring: Measurement of leaf health, chlorophyll detection, ripeness level, crop mapping, fertilizing, Drone technology for soil field analysis and assistive operations.

Module VI: (6 Hrs)

Technologies for farming: Water quality monitoring, micro-irrigation system, solar pump and lighting system, Fencing, Android based automation, Agricultural Robots, Standards for agriculture

Text Books

1. The nature and properties of Soils: Eurasia Publishing House Pvt Ltd, New Delhi Brady, Nyle C. (1988).
2. Measurement Systems; Application and Design: Doeblin, D.O. McGraw Hill, 1984.

Reference Books

1. Smart Agriculture: An Approach towards Better Agriculture Management : Editor: Prof. Dr. Aqeel-ur-Rehman, OMICS Group,
2. Practical MEMS: Design of microsystems, accelerometers, gyroscopes, RF MEMS, optical MEMS, and microfluidic systems: Ville Kaajakari, Small Gear Publishing
3. Principles of Industrial Instrumentation: Patranabis. D, Tata McGraw Hill, 1995
4. Mechatronics: Bolton, W. 2004.Pearson Education Asia
5. Photo-voltaic energy systems: Design and Installation: Buresch, Mathew. 1983. McGraw- Hill Book Company, New York.

V / VII Semester
Department of Electronics Engineering

Course Code: ENT 398-2/ENT 498-2 **Course : Arduino Playground**

L: 03hrs, T: 00 Hr., Per Week **Total Credits : 3**

Course Outcomes

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

1. Create sketches, libraries inside the Arduino Development Environment.
2. Measure various physical parameters using sensors.
3. Implement various communication protocols for wired and wireless communication.

Syllabus

Module I: (6 Hrs)

Arduino Cram Session: Arduino platform, Prototyping environment, Electronic component overview, Arduino Development Environment, setting up the Arduino board, creating sketches, using Libraries, using example codes, Debugging Using the Serial Monitor

Module II: (6 Hrs)

Let Us (Arduino) C: Arduino C, Data types, Decision making, Loops, Functions, Pointers, Structures

Module III: (6 Hrs)

Sensing the World: Sensors, Digital and Analog signals, Temperature sensors, Humidity sensors, Obstacle sensors, Ultrasonic sensor, Accelerometer and gyro

Module IV: (6 Hrs)

Communicating with the world: Wired and Wireless communication, Communication Protocols, Interfacing Communication Modules with Arduino

Module V: (6 Hrs)

Playing with Displays: Interfacing Alphanumeric LCD Display, Formatting Text, Creating Custom Characters, Interfacing Graphical LCD Display, Creating Bitmapsfor Use with a Graphical Display

Module VI: (5 Hrs)

Making Noise: Playing Tones, playing a melody,Types of motors – DC, Servo, Stepper, Motor Drivers, Speed and direction control

Text Books:

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

V / VII Semester
Department of Electronics Engineering

Course Code : ENT 398-3/ENT498-3 **Course : Consumer Electronics**

L: 03Hrs, T: 00 Hr., Per week **Total Credits : 3**

Course Outcomes

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

1. Understand electronics engineering concepts used in consumer electronics systems.
2. Identify the need of preventive maintenance in various electronic appliances.
3. Use different product safety, compliance standards and techniques associated with electronic products.
4. Evaluate and analyze different electronic products and systems based on specifications.
5. Manage multi-faceted and multi-disciplinary projects with significant technical considerations using a broad systems perspective.
6. Foster a desire to continue life-long learning.

Syllabus

Module I: (7 Hrs)

Audio System : Microphones, loudspeakers baffle and enclosure, Acoustics, mono, stereo, Quad, Amplifying System, Equalizers and Mixers Synthesizers, Commercial Sound, Theater Sound System.

Module II: (7 Hrs)

Video Systems and Displays: Monochrome, Color TV standards, TFT, Plasma, HDTV, LCD,LED TV, Direct-To- Home(DTH- Set Top Box), Video Telephone and Video Conferencing.

Module III: (7 Hrs)

Domestic & Consumer Appliances: Washing machines, Microwave ovens, Air-conditioners and Refrigerators, Computers office System, Telephone & Mobile Radio System

Module IV: (7 Hrs)

Power Supplies SMPS/UPS and Preventive Maintenance and others systems such as Remote controls, Bar codes, RFID

Module V: (7 Hrs)

Product Compliance: Product safety and liability issues; standards related to electrical safety and fire hazards, EMI/EMC requirements, design techniques for ESD, RF interference and immunity,line current harmonics and mains voltage surge.

Text Books

1. Consumer Electronics; SP Bali; Pearson Education.
2. Consumer Electronics; J.S. Chitode; Technical Publications, Pune.

V / VII Semester
Department of Electronics Engineering

Course Code : ENT 398-4/ENT498-4 **Course : Drone Technology**

L: 03Hrs, T: 00 Hr., Per week **Total Credits : 3**

Course Outcomes

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

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

Module - I : (5 Hrs)

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

Module - II : (6 Hrs)

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

Module - III : (6 Hrs)

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

Module - IV : (6 Hrs)

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

Module - V : (6 Hrs)

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

Module - VI : (6 Hrs)

Drone inspection, maintenance resources and standards, opportunities and threats from ethical and legal perspectives, frequency spectrum issues

Drone applications: agriculture, defence, product delivery, aerial photography, and futuristic drone applications.

Text Books

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

Reference Book

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

IV Semester (Minor Specialization)
Department of Electronics Engineering

Course Code: ENTM42 **Course : Sensor and Actuators for Cyber Physical Systems**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

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

1. Understand different types of sensors and transducers.
2. measure various physical parameters and Working principle used in Industry
3. Understand actuators, drivers and their applications.

Module - I : Cyber Physical Systems

Cyber Physical Systems (CPS), Basics of Process control principles, Continuous and Discrete Control systems, An overview of Computer process control, Types of Automation; CPS architecture model, Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Industrial revolutions

Module - II : Sensor- based Measurement Systems

General Concepts And Terminology, Sensor Classification, General Input-Output Configuration, Static Characteristics Of Measurement Systems, Dynamic Characteristics, Other Sensor Characteristics, Primary Sensors, Materials For Sensors, Intelligent sensors , Micro sensor Technology, Estimation of errors and Calibration.

Module - III : Sensors

motion, pressure, force, temperature, load cell, Flow measurement techniques, Measurement of level, humidity and pH, Proximity Sensors: Typical Sensor Characteristics, Technologies For Proximity Sensing, Electro-Optical Sensors, Capacitive Sensors, Magnetic Sensors.

Module - IV : Transmitters and Signal Conditioning

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal Standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for sensors, Smart and Intelligent transmitters

Module - V : Actuator Control

Actuators fundamentals, working principles, Control: Mechanical switches, Solid-state switches, Relays and Contactors, Starter: DOL, Star Delta, Auto Transformers Starters, Drivers for DC motors, Variable Frequency Drive, Flow Control Valves, Proportional and Servo Valves,

Module - VI : Actuators

Power Range for Motors and Drives, Motor Installation Wiring, Determination of Input Power and Current, Rating of Cables, FusesRating, AC Motor,Step motors: Principles, Construction and Drives, Servo Motor, Piezoelectric motor, Economic Selection of Electric Motors,

Pneumatic Control Systems : System Components, Hydraulic Actuator Systems : Principles, Components and Symbols, Pumps and Motors.

Text Books

1. Ramon Pallas & John G. Webster, "Sensors and Signal Conditioning", John Wiley & Sons, 2nd Ed., 2001.
2. Electric Motor Drives, Fundamentals, Types and Applications Austin Hughes Elsevier ,Third edition 2006

Reference Books

1. Patranabis D., "Sensors and Transducers", Prentice-Hall India, 2nd Ed., 2004.
2. Electric Motors and Control Systems-Career Education Frank Petruzella McGraw-Hill Companies, Inc. 2010
3. A Course in Electrical Installation Estimating & Costing J, B, Gupta S. K. Kataria& Sons 9th Edition 2012
4. Electrical motors applications and control. M V Deshpande, PHI publications 2010

V Semester (Minor Specialization)
Department of Electronics Engineering

Course Code: ENTM52 **Course : Factory Automation**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

After successfully completing the course students will be able to

1. Understand process control, PLC architecture and interfacing
2. Develop PLC ladder logic for industrial applications
3. Design SCADA/HMI based automation systems for industrial applications

Module - I : Introduction to Programmable Logic Controllers

Introduction to smart factory, Comparison of Industry 4.0 Factory and old Factory, Process control principle, Architecture of Industrial Automation Systems, history of the PLC; Functions of PLC, Architecture and Selection of PLC , PLC input & output modules; Solid state memory; the processor, power supplies. PLC advantage & disadvantage, PLC Application. Programming equipment; Process scanning consideration, PLC Installation practices.

Module - II : Fundamentals of logic

Processor Memory Organization and mapping , Addressing , Program Scan cycle , PLC Programming languages, developing circuits from Boolean Expression, Relay type instructions, Internal Relay Instructions, Logic functions, Latching, Multiple outputs, Interlocking, Timer and counter, Cascading timers and counters,

Module - II : Ladder programming

Latch instruction; Arithmetic and logical instruction, Different Conversion Instructions, Comparison Instructions, Subroutines, Shift registers, sequencer function, ON/OFF switching devices,

I/O analog devices, Analog PLC operation, PID control of continuous processes, simple closed loop systems, PLC interface, and Industrial process example.

Module - IV : PLC interfacing

Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level.

Developing a ladder logic for Sequencing of motors, Tank level control, ON-OFF temperature control, bottle filling plant, car parking etc.

Motors Controls: AC Motor starter, DC motor controller, Speed and direction controller

Module - V : SCADA

Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures, SCADA systems in operation and control, Process Field bus (Profibus), interfacing of SCADA with PLC, Case studies.

Module - VI : Human Machine Interface (HMI)

HMI: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, Block Diagram, Types, Interaction Devices, Graphical User Interface, Screen Design, Industrial Case studies.

Text Books

1. Frank D. Petruzella , Programmable Logic Controllers, McGraw Hill; Fifth edition.
2. KS Manoj, Industrial Automation with SCADA: Concepts, Communications and Security, Notion Press; 1st Edition

Reference Books

1. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd
2. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication
3. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education
4. Kalbande, Kanade, Iyer, Galitzs, Human Machine Interaction, Wiley Publications.
5. Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition

VI Semester (Minor Specialization)
Department of Electronics Engineering

Course Code : ENTM62 **Course : Industrial IoT Networks**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Objective

After successfully completing the course students will be able to

1. Educate on the basic concepts of data networks
2. Introduce the basics of internetworking and serial communications
3. Provide details on HART and Field buses
4. Introduce industrial Ethernet and wireless communication

Module - I : Local Area Network

Computer Networks in instrumentation, Components of Computer Networks: hardware and software, Network topologies: Star, Ring, Bus, Mesh, Network Classification Based on Transmission Technologies: Point-to-point, broadcast, Based on scale: LAN, WAN, MAN, VPN, Internet Based on Architecture: Peer to Peer, Client Server, advantages of Client Sever over Peer-to-Peer Model

Module - II : Network Devices and Communication Protocol

Basics of Protocol, OSI-ISO and TCP/IP Reference Models, functional description of Layers, IP layer Protocols: IPv4 and IPv6 frame Format (Limited to format only), Internet addressing: Network addressing, Subnet and subnet masking, gateway addressing, broadcast addressing, dotted decimal notation, loopback addressing, Domain Name System(DNS): Introduction, mapping to IP addresses

Module - III : Network Media and Hardware

Transmission Media: Unguided and Guided media, Wired and Wireless, UTP, Coaxial and Fiber optical cable, Types of Connectors: RJ-45, RJ-11, BNC, BNC –T, BNC Terminator, Fiber optic connectors:-Subscriber Channel(SC), Straight Tip(ST), Mechanical transfer –registered jack(MT- RJ) connectors, Network Interface Card (NIC), ARCNET, Ethernet. Network connecting devices: Repeater, Hub, Bridge, Switch , Router, Gateway, Access point, Wireless Access points, Servers introduction : File, Print, Mail, Proxy, Web

Module - IV : Hart and Field Bus

Introduction : Evolution of signal standard, HART communication protocol, HART networks - HART commands, HART applications, Field bus: Introduction General Field bus architecture, Basic requirements of Field bus standard, Field bus topology, Interoperability, Interchangeability Introduction to OLE for process control (OPC).Module V- Industrial Ethernet and Wireless Communication.

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet – Radio and wireless communication, Introduction, components of radio link – radio spectrum and frequency allocation – radio MODEMs, Introduction to wireless HART and ISA100.

Text Books

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting Newnes Publication, Elsevier First Edition, 2004
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. Behrouz Forouzan , Data Communications and Networking ,3RD edition, Tata McGraw hill,2006.

References

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2ndEdition, 2001.
3. William Stallings, Wireless Communication and Networks, Prentice Hall of India, 2nd Edition, 2005.

VII Semester (Minor Specialization)
Department of Electronics Engineering

Course Code : ENTM72 **Course : Technologies of Smart Factory**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

After successfully completing the course students will be able to

1. Describe IOT,IIOT
2. Understand, design and develop the real life IoT applications using off the shelf hardware and software
3. Understand various IoT Layers and their relative importance
4. Study various IoT platforms and Security
5. Realize the importance of Data Analytics in IoT
6. Understand the concepts of Design Thinking

Module - I : Industry 4.0 (7hrs)

Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis

Module - II : Industrial IoT (7hrs)

IIoT - Introduction, Industrial IoT: Business Model and Referece Architerture: IIoT - Business Models, Industrial IoT - Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking

Module - III : IIoT Analytics (7hrs)

Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop.

Module - IV : IoT Security (7hrs)

Industrial IoT : Security and Fog Computing -Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT

Module - V : Case Study (7hrs)

Industrial IoT - Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies :Milk Processing and Packaging Industries, Manufacturing Industries

Text Books

1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017
2. "Industrial Internet of Things: Cybermanufacturing Systems"by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

Reference Books

1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018

IV Semester (Honors Specialization)
Department of Electronics Engineering

Course Code : ENTH42 **Course : Introduction to Artificial Intelligence and Machine Learning**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

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

1. Represent given problem using state space representation and apply uninformed and informed search techniques on it.
2. Understand the fundamental concepts, and challenges of machine learning: data, model selection, model complexity, etc. and its applications to solve real-world problems.
3. Solve the AI problems by using logic programming.
4. Apply uncertainty theory-based techniques like probability theory in AI and Machine Learning system.
5. Implement machine learning solutions to classification, regression, and clustering problems with Python programming language and test them with benchmark data sets.

Syllabus

Module - I : (05 Hours)

Introduction : Basics of problem solving, problem representation; Search Techniques: Problem size, complexity; Uninformed search techniques: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS.

Module - II : (06 Hours)

Informed search techniques : Heuristic Based Search, Greedy Based First Search, A* Search; Local Search algorithms: Hill-climbing, Simulated Annealing, Genetic Algorithms.

Module - III : (07 Hours)

Constraint Satisfaction Problems, Adversarial Search, The minmax algorithm, Alpha-Beta pruning. Propositional Logic: Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, First Order Logic, Inference in FOL, Unification, Forward Chaining, Backward Chaining, and Resolution.

Module - IV : (06 Hours)

Introduction to machine learning, supervised learning algorithms: Linear and Logistic Regression – Bias/Variance Trade-off, Regularization, Variants of Gradient Descent, unsupervised learning algorithms.

Module - V : (06 Hours)

Artificial Neural Networks, Perceptron Learning, Feedforward Neural Networks, Multilayer networks and Backpropagation algorithm, Initialization, Training & Validation, Introduction to Deep Neural networks.

Module - VI : (05 Hours)

Uncertainty Knowledge and Reasoning : Probability and Baye's Theorem, Statistical reasoning: Bayesian networks, Naïve bayes algorithm, Introduction to expert system.

Text Book

1. Artificial Intelligence: A Modern Approach; Stuart Russel and Peter Norvig, Third Edition; Pearson Education, 2009.
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, First edition, Springer, 2006.

Reference Books

1. The Elements of Statistical Learning Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Second Edition, Springer, 2009.
2. Machine Learning, by Mitchell Tom, First edition, McGraw Hill, 1997.
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, & Francis Bach, MIT Press, 2017.
4. Introduction to Machine Learning by Ethem Alpaydin, Third edition, PHI Learning, 2015.

V Semester (Honors Specialization)
Department of Electronics Engineering

Course Code : ENTH52 **Course : Deep Learning for Visual Recognition**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

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

1. Understand the major technology trends driving Deep Learning.
2. Build, train and apply fully connected deep neural networks.
3. Know how to implement efficient (vectorized) neural networks.
4. Understand the key parameters in a neural network's architecture.

Syllabus

Module -I : (05 Hours)

Introduction to Deep Neural networks (DNNs), Building blocks of DNNs

Module - II : (06 Hours)

Convolutional Neural Networks (CNNs)- Convolution and pooling

Module - III : (07 Hours)

CNN Architectures- AlexNet, LeNet, VGG, GoogLeNet, ResNet, DenseNet, Inception Network etc.

Module - IV : (06 Hours)

Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO, Visualizing Convolutional Neural Networks,

Module - V : (06 Hours)

Recurrent Neural Networks ¬– RNN, LSTM, GRU, Applications

Module - VI : (05 Hours)

Efficient Convolutional Neural Networks- Mobile Nets, SqueezeNet.

Text Book

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, & Francis Bach, MIT Press, 2017.

Reference Books

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

VI Semester (Honors Specialization)
Department of Electronics Engineering

Course Code : ENTH62 | **Course : Edge for AI Fundamentals**

L: 04 Hrs., T: 0 Hrs. Per week | **Total Credits : 04**

Course Outcomes

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

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

Syllabus

Module - I : (5 Hours)

Fundamentals of edge computing : Introduction to edge computing, Trends, Industrial applications, Edge intelligence and intelligent edge

Module - II : (7 Hours)

Paradigms of Edge Computing : Cloudlet and Micro Data Centers, Fog Computing, Mobile and Multi-Access Edge Computing, Edge Computing Terminologies, AI Hardware for Edge Computing, Edge Computing Frameworks, Virtualizing the Edge

Module - III : (7 Hours)

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

Module - IV : (7 Hours)

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

Module - V : (7 Hours)

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

Module - VI : (7 Hours)

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

Text book

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

Reference Book

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

VII Semester (Honors Specialization)
Department of Electronics Engineering

Course Code : ENTH72 **Course : Hardware Designing for AI/ML Applications**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes:

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

1. understand the key design considerations for efficient DNN processing
2. understand tradeoffs between various hardware architectures and platforms
3. develop the DNN using software framework
4. analyze the architecture of DNN accelerators with given target area-power-performance metrics
5. Review the performance using case studies

Syllabus

Module - I : Computing platform : Processors- GPU, CPU, NPU

Module - II : Embedded AI devices : PYNQ-Z2, Arduino UNO R3, Intel Movidius NCS2, Raspberry Pi 4, Google Coral USB Accelerator, NVIDIA Jetson Nano

Module - III : Communication : Wireless Technology: Wi-Fi 5, Wi-Fi 6 ,4G LTE, 5G, NB-IoT,Bluetooth 4.x, 5.x

Module - IV : Software Framework : Pytorch, TinyML, Keras, Tensorflow

Module - V : Accelerator : Approximate Computing, FPGA-based Accelerators, Sparsity, Reduction precision, Systolic Arrays, HW-SW Co-Design

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

Text books

1. Practical Deep Learning for Cloud, Mobile and Edge: Real-World AI & Computer-Vision Projects Using Python, Keras & Tensorflow by Anirudh Koul, Sidha Ganju, Mehere Kasam, O'Reilly; Illustrated edition (1 November 2019)
2. IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security, 2nd Edition, by Perry Lea, Packt Publishing Limited; 2nd Revised edition
3. Hardware Architectures for Deep Learning, by Masoud Daneshtalab, Mehdi Modarressi, Institution of Engineering and Technology.

VII Semester (Honors Specialization)
Department of Electronics Engineering

Course Code : ENTH73 **Course : Data Management and Analysis for IoT**

L : 04 Hrs., P : 0 Hrs. Per week **Total Credits : 04**

Course Outcomes

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

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

Syllabus

Module - I : (5Hrs)

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

Module - II : (7 Hrs)

Indexing Structures : Single level and Multilevel Indexes, B Tree and B+ Tree Indexes, Hash and bitmap based indexing, Index Structures for Single Dimensional and Multidimensional Databases

Module - III : (8Hrs)

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

Module - IV : (7 Hrs)

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

Module - V : (6Hrs)

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

Module - VI : (7Hrs)

Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis.

Reference Book

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

Text Book

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

IV Semester (Honors in IOT)
Department of Electronics Engineering

Course Code : ENTH43 **Course : Introduction to IOT**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

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

1. understand the basics of networking
2. gain the knowledge about IoT standards
3. realize the basic applications using Arduino and Raspberry pi
4. illustrate different real world applications

Syllabus

Module - I : (7Hrs)

Basics of Networks, TCP/IP model,IP Addresses, application layer protocols, HTTP, MQTT, WWW, constraint application protocol,stacks

Module - II : (7Hrs)

Introduction to IoT, evolution of IoT, IoT and SCADA, Big Data, IoT Standards, requirement, Platforms, relevance of IoT, security

Module - III : (7Hrs)

Interoperability in IoT, Machine-to-Machine Communications, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Sensing, Actuation, Sensor Networks

Module - IV : (7Hrs)

Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.

Module - V : (7Hrs)

Introduction to SDN, Fog Computing, IoT application case studies:Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Agriculture, Healthcare, Activity Monitoring, IoT in India: Smart India projects, Challenges in IoT

Text Books

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

V Semester (Honors in IOT)
Department of Electronics Engineering

Course Code : ENTH53 **Course : Sensor Interfacing with Arduino and ESP8266**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

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

1. Know about the open source hardware platforms like Arduio and ESP
2. Learn the working of sensors and actuators
3. Understand the working of serial communication protocols

Syllabus

Module - I : (6Hrs)

Introduction to Arduino Prototyping Platform : Arduino IDE, Arduino C, Setting up the Arduino board, creating sketches,using Libraries, using example codes, Debugging Using the Serial Monitor.

Module - II : (7Hrs)

Sensor interfacing with Arduino : Analog and digital sensors, Temperature sensors, Humidity sensors, Obstacle sensors, Ultrasonic sensor, Accelerometer and gyro, etc.

Module - III : (7Hrs)

Serial Communication in Arduino : Serial and parallel communication, Serial communication protocols, UART, I2C, SPI, Wired and Wireless communication, Interfacing Communication Modules with Arduino.

Module - IV : (7 Hrs)

Interfacing Displays and Actuators : 16x2 LCD, Graphical LCD, Graphical OLED, Arduino Tone functions, Melody generation on a piezo buzzer, Speed and direction control of DC, Servo and, Stepper Motor.

Module - V : (6Hrs)

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

Module - VI : (7Hrs)

Interfacing sensors and actuators with ESP8266 : LDR, Temperature sensor, Humidity sensor, IR sensor, OLED, RGB LED, Servo motor, etc.

Text Books

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

VI Semester (Honors in IOT)
Department of Electronics Engineering

Course Code : ENTH63 **Course : Cloud Computing Using Raspberry Pi**

L: 04Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits : 04**

Course Outcomes

At the end of the course the student will be able to

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

Syllabus

Module - I (6 Hours)

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

Module - II (6 Hours)

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

Module - III (6 Hours)

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

Module - IV (6 Hours)

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

Module - V (6 Hours)

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

Text Books

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

Reference Books

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