SRI RAMAKRISHNA INSTITUTE OF TECHNOLOGY
COIMBATORE-10
(An Autonomous Institution affiliated to Anna University)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM STRUCTURE

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER – I

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20HSG01	Technical English	HS	2	0	2	4	3
2.	20MHG01	Calculus and Linear Algebra	BS	3	1	0	4	4
3.	20PHG01	Engineering Physics	BS	3	1	0	4	4
4.	20CHG01	Engineering Chemistry	BS	3	1	0	4	4
5.	20ITG01	Programming for Problem Solving using C	ES	3	0	0	3	3
PRACTICALS								
6.	20MEG02	Engineering Workshop	ES	0	0	4	4	2
7.	20PHG02	Engineering Physics Laboratory	BS	0	0	3	3	1.5
8.	20ITG02	Programming in C Laboratory	ES	0	0	4	4	2
			Total	**14**	**3**	**13**	**30**	**23.5**

SEMESTER – II

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20HSG02	Universal Human Values II - Understanding Harmony	HS	3	0	0	3	3
2.	20MHG02	Differential Equations and Complex Variables	BS	3	1	0	4	4
3.	20CSG01	Object Oriented Programming using C++	ES	3	0	0	3	3
4.	20ECG01	Electric Circuits	ES	3	0	0	3	3
5.	20EC001	Electron Devices	PC	3	0	0	3	3
PRACTICALS								
6.	20MEG01	Engineering Graphics	ES	0	0	4	4	2
7.	20CHG02	Engineering Chemistry Laboratory	BS	0	0	3	3	1.5
8.	20CSG02	Programming in C++ Laboratory	ES	0	0	4	4	2
			Total	**18**	**1**	**11**	**30**	**21.5**
9.	20AC001	Environmental Science and Engineering	AC	3	0	0	3	-

SEMESTER – III

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20MHG03	Transforms and Partial Differential Equations	BS	3	1	0	4	4
2.	20EEG05	Electrical Engineering	ES	2	0	2	4	3
3.	20EC002	Analog Electronics	PC	3	0	0	3	3
4.	20EC003	Digital Electronics	PC	3	0	0	3	3
5.	20EC004	Electromagnetic Fields and Waves	PC	3	0	0	3	3
6.	20xxExx	Open Elective –I	OE	3	0	0	3	3
PRACTICALS								
7.	20EC005	Analog Electronics Laboratory	PC	0	0	3	3	1.5
8.	20EC006	Digital Electronics Laboratory	PC	0	0	3	3	1.5
			Total	**17**	**1**	**8**	**26**	**22**

SEMESTER – IV

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20MHG05	Probability and Random Processes	BS	3	0	0	3	3
2.	20EC007	Linear Integrated Circuits	PC	3	0	0	3	3
3.	20EC008	Signals and Systems	PC	3	0	0	3	3
4.	20EC009	Transmission Lines and	PC	3	0	0	3	3

		Waveguides						
5.	20EC010	Microprocessor and Microcontroller	PC	3	0	0	3	3
6.	20xxExx	Open Elective –II	OE	3	0	0	3	3
PRACTICALS								
7.	20EC011	Integrated Circuits Laboratory	PC	0	0	3	3	1.5
8.	20EC012	Microprocessor and Microcontroller Laboratory	PC	0	0	3	3	1.5
			Total	**18**	**0**	**6**	**24**	**21**

SEMESTER – V

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20HMG05	Professional Practice and Ethics	HS	2	0	0	2	2
2.	20EC013	Digital Signal Processing	PC	3	0	0	3	3
3.	20EC014	Analog Communication	PC	3	0	0	3	3
4.	20EC015	Control Systems	PC	3	0	0	3	3
5.	20ECPxx	Professional Elective-I	PE	3	0	0	3	3
6.	20xxExx	Open Elective – III	OE	3	0	0	3	3
PRACTICALS								
7.	20EC016	Digital Signal Processing Laboratory	PC	0	0	3	3	1.5
8.	20EC017	Analog Communication Laboratory	PC	0	0	3	3	1.5
			Total	**17**	**0**	**6**	**23**	**20**

SEMESTER – VI

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20EC018	Digital VLSI Design	PC	3	0	0	3	3
2.	20EC019	Digital Communication	PC	3	0	0	3	3
3.	20EC020	Antennas and Wave Propagation	PC	3	0	0	3	3
4.	20ECPxx	Professional Elective-II	PE	3	0	0	3	3
5.	20xxExx	Open Elective –IV	OE	3	0	0	3	3
PRACTICALS								
6.	20EC021	VLSI Design Laboratory	PC	0	0	3	3	1.5
7.	20EC022	Digital Communication Laboratory	PC	0	0	3	3	1.5
8.	20EC901	Design Project	EC	0	0	6	6	3
			Total	**18**	**0**	**12**	**30**	**21**
9.	20AC002	Constitution of India	AC	3	0	0	3	-

SEMESTER – VII

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	20EC023	Optical Communication	PC	3	0	0	3	3
2.	20EC024	RF and Microwave Communication	PC	3	0	0	3	3
3.	20ECPxx	Professional Elective-III	PE	3	0	0	3	3
4.	20ECPxx	Professional Elective-IV	PE	3	0	0	3	3

5.	20ECPxx	Professional Elective-V	PE	3	0	0	3	3
PRACTICALS								
6.	20EC025	Optical and Microwave Laboratory	PC	0	0	4	4	2
7.	20EC902	Final Year Project - I	EC	0	0	6	6	3
			Total	**15**	**0**	**10**	**25**	**20**

SEMESTER – VIII

S. NO.	**COURSE CODE**	**COURSE NAME**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
THEORY								
1.	20ECPxx	Professional Elective-VI	PE	3	0	0	3	3
PRACTICALS								
2.	20EC903	Final Year Project - II	EC	0	0	16	16	8
			Total	**3**	**0**	**16**	**19**	**11**

TOTAL NUMBER OF CREDITS: 160

PROFESSIONAL ELECTIVES

ELECTIVE – I & II GROUP

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	20ECP01	Electronic Measurements	PE	3	0	0	3	3
2.	20ECP02	Advanced Digital System Design	PE	3	0	0	3	3
3.	20ECP03	Computer Architecture	PE	3	0	0	3	3
4.	20ECP04	Advanced Microprocessors and Microcontrollers	PE	3	0	0	3	3
5.	20ECP05	Optoelectronics	PE	3	0	0	3	3
6.	20ECP06	Biomedical Instrumentation	PE	3	0	0	3	3
7.	20ECP07	Numerical Analysis	PE	3	0	0	3	3
8.	20ECP08	Nano Electronics	PE	3	0	0	3	3
9.	20ECP09	Electromagnetic Interference and Compatibility	PE	3	0	0	3	3
10.	20ECP10	Telecommunicatio n Switching and Networks	PE	3	0	0	3	3

ELECTIVE –III & IV GROUP

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	20ECP11	Digital Image Processing	PE	3	0	0	3	3
2.	20ECP12	Principles of Satellite Communication	PE	3	0	0	3	3
3.	20ECP13	High Performance Communication Networks	PE	3	0	0	3	3
4.	20ECP14	Real time	PE	3	0	0	3	3

		Concepts for Embedded Systems						
5.	20ECP15	Software for Embedded Systems	PE	3	0	0	3	3
6.	20ECP16	Artificial Intelligence	PE	3	0	0	3	3
7.	20ECP17	Low Power VLSI Design	PE	3	0	0	3	3
8.	20ECP18	Optical Networks	PE	3	0	0	3	3
9.	20ECP19	Electronic Packaging	PE	3	0	0	3	3
10.	20ECP20	Introduction to MEMS System Design	PE	3	0	0	3	3

ELECTIVE – V & VI GROUP

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	20ECP21	Wireless Communication	PE	3	0	0	3	3
2.	20ECP22	Cognitive Radio	PE	3	0	0	3	3
3.	20ECP23	Wireless Networks	PE	3	0	0	3	3
4.	20ECP24	Cryptography and Network Security	PE	3	0	0	3	3
5.	20ECP25	Wireless Sensor Networks	PE	3	0	0	3	3
6.	20ECP26	Introduction to Embedded Controllers	PE	3	0	0	3	3
7.	20ECP27	ASIC Design	PE	3	0	0	3	3
8.	20ECP28	Machine Learning	PE	3	0	0	3	3
9.	20ECP29	Deep Learning	PE	3	0	0	3	3
10.	20ECP30	Cognitive Robotics	PE	3	0	0	3	3
11.	20ECP31	Testing of VLSI circuits	PE	3	0	0	3	3
12.	20ECP32	Reconfigurable Architectures	PE	3	0	0	3	3

OPEN ELECTIVES

S. NO.	COURSE CODE	COURSE NAME	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
OPEN ELECTIVES OFFERED BY CSE DEPARTMENT TO OTHER B.E. PROGRAMMES								
1	20CSE01	Basics of Python Programming	OE	3	0	0	3	3
2	20CSE02	Introduction to AI	OE	3	0	0	3	3
3	20CSE03	Fundamentals of Data Science	OE	3	0	0	3	3
4	20CSE04	Basics of Internet Programming	OE	3	0	0	3	3
5	20CSE05	Introduction to Soft Computing	OE	3	0	0	3	3
OPEN ELECTIVES OFFERED BY EEE DEPARTMENT TO OTHER B.E. PROGRAMMES								
1	20EEE01	Energy Management Systems	OE	3	0	0	3	3
2	20EEE02	Medical Instrumentation	OE	3	0	0	3	3
3	20EEE03	PLC Programming	OE	3	0	0	3	3
4	20EEE04	Renewable Energy Systems	OE	3	0	0	3	3
5	20EEE05	Virtual Instrumentation & Data Acquisition	OE	3	0	0	3	3
6	20EEE06	Electric Vehicles	OE	3	0	0	3	3
OPEN ELECTIVES OFFERED BY IT DEPARTMENT TO OTHER B.E. PROGRAMMES								
1	20ITE01	Big Data Analytics and its Applications	OE	3	0	0	3	3
2	20ITE02	Cloud Computing Fundamentals	OE	3	0	0	3	3
3	20ITE03	Fundamentals of	OE	3	0	0	3	3

		Internet of Things						
4	20ITE04	Introduction to Database Management Systems	OE	3	0	0	3	3
5	20ITE05	Web Interface Design and Development	OE	3	0	0	3	3
6	20ITE06	Introduction to Data Structures	OE	3	0	0	3	3
7	20ITE07	Principles of Software Engineering	OE	3	0	0	3	3
OPEN ELECTIVES OFFERED BY MECHANICAL ENGINEERING DEPARTMENT TO OTHER B.E. PROGRAMMES								
1	20MEE01	Automotive Fundamentals	OE	3	0	0	3	3
2	20MEE02	Computer Aided Design	OE	3	0	0	3	3
3	20MEE03	Introduction to Power Plant Engineering	OE	3	0	0	3	3
4	20MEE04	Introduction to Robotics	OE	3	0	0	3	3
5	20MEE05	3D Printing	OE	3	0	0	3	3
OPEN ELECTIVES OFFERED BY ECE DEPARTMENT TO OTHER B.E. PROGRAMMES								
1	20ECE01	Electronic Measurements and Instrumentation	OE	3	0	0	3	3
2	20ECE02	Microcontrollers and its Applications	OE	3	0	0	3	3
3	20ECE03	Introduction to Embedded Systems	OE	3	0	0	3	3
4	20ECE04	Nano Electronics and Sensors	OE	3	0	0	3	3
5	20ECE05	Principles of VLSI Systems	OE	3	0	0	3	3

6	20ECE06	Measurement, Instrumentation and Sensors	OE	3	0	0	3	3
7	20ECE07	Principles of Embedded Systems	OE	3	0	0	3	3

CREDIT DISTRIBUTION

S. No.	Course Work - Subject Area	Credits/Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management Courses (HSMC)	3	3	0	0	2	0	0	0	**8**
2	Basic Sciences Courses (BS)	13.5	5.5	4	3	0	0	0	0	**26**
3	Engineering Science Courses (ES)	7	10	3	0	0	0	0	0	**20**
4	Professional Core Courses (PC)	0	3	12	15	12	12	8	0	**62**
5	Professional Elective Courses (PE)	0	0	0	0	3	3	9	3	**18**
6	Open Electives (OE)	0	0	3	3	3	3	0	0	**12**
7	Employability Enhancement Courses (EC)	0	0	0	0	0	3	3	8	**14**
	Total	**23.5**	**21.5**	**22**	**21**	**20**	**21**	**20**	**11**	**160**

FIRST SEMESTER SYLLABUS

20HSG01	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

1. Take part in fluent communication and to use proper grammar in formal writing.
2. Infer analytic based writing, email writing, structures of grammar and to interpret TED talks.
3. Understand various grammatical concepts, extensive writing and to participate in role-play activities.
4. Interpret graphics, reading comprehension and to take part in presentation.
5. Organize technical reports, proposals and resume preparation.

COURSE CONTENT:

Importance of Communication

Listening: Importance of listening in the corporate world. Exposure to structured talks
Speaking: Self-introduction, Peer introduction, Extempore
Reading: Skimming and Scanning, Note-Making
Writing: Parts of Speech, Tense, Subject-Verb Agreement, Prepositions, Instructions Formal Letters (Quotations, Clarification, Placing orders & Complaint letter)

Formal Communication

Listening: Listening to motivational talks / TED talks, Note-taking practice.
Speaking: Describing a product/place, Conversation practice, Telephonic Conversation.
Reading: Reading Comprehension, Reading for specific information.
Writing: Voices, Compound Nouns, Paragraph Writing, Recommendations, Email writing, Analytical and issue based essays.

Writing Strategies

Listening: Listening to Announcements, Listening to Product description and Process
Speaking: Role-Play, Picture description.
Reading: Cloze reading, Introduction to Blogs, Social media etiquette.
Writing: Cause and Effect, Gerunds and Infinitives, Tag Questions, Modal Verbs, Checklist.

Presentation Skills

Listening: Listening to Group Discussion and Interview Skills.
Speaking: Presentation on the technical topic, Sales talk.
Reading: Interpreting pictures of visual graphics.
Writing: If Conditional Clause, Use of sequence words, Process Description.

Technical Communication

Listening: Listening to talks of scientific nature, Listening for specific information.
Speaking: Giving impromptu talks, Giving a summary of an article.
Reading: Journals, Articles both general and technical.
Writing: Purpose and Function, extended definitions Wh- questions, Resume Writing, Report (Industrial visit reports, Accident report, Feasibility Reports) Proposals.

List of Laboratory Exercises

1. Speaking - Self and Peer Introduction
2. Speaking - General Conversation on Business Context
3. Listening to short recordings
4. Listening to conversation
5. Technical Presentation (PPT)

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand listening skills, use proper grammar, proficiency in oral communication and to write in formal English.

CO2: Inculcate the concept of email writing, structures of grammar and to interpret advance listening skills.

CO3: Infer the strategies of academic writing and to use advance grammar mechanics.

CO4: Predict graphics, reading comprehension and to participate in presentation.

CO5: Construct technical reports, documentations, proposals, read journals and listen for specific information.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-

Program Articulation matrix

20HSG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	3	-	-	-	-	-	-

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3. Rizvi M.Ashraf, “Effective Technical Communication”, Tata McGraw-Hill Publishing Company Limited, Fourth Edition, 2010.
4. Gerson Sharon J, Steven M.Gerson, “Technical Writing-Process and Product”, Pearson Education Pvt. Ltd. Third Edition, 2009.
5. Sanborn Pfeiffer, Padmaja, “Technical Communication, A Practical Approach” Pearson Publication, Sixth Edition, 2007.

20MHG01	CALCULUS AND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To explain about functions of several variables which is useful in optimization.
- To make the students understand different methods for integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

COURSE CONTENT:

Matrices

Introduction – Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Stretching of an Elastic Membrane – Vibrating System of two masses on two springs.

Differential Calculus

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem

Functions of Several Variables

Partial derivatives – Total derivative – Differentiation of implicit functions – Change of variables – Jacobian – Partial differentiation of implicit functions – Taylor's series for functions of two variables Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

Integral Calculus

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

Multiple Integrals

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Solve practical problems that can be expressed as matrix algebra.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Determine maxima and minima of multi variable functions.

CO4: Apply different methods of integration in solving practical problems.

CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

Program Articulation matrix

20MHG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

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2. Grewal. B.S, "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2017
3. James Stewart, "Calculus, Early Transcendental", 7th Edition, Cengage learning, New Delhi, 2018.
4. Joel Hass, Christopher Heil and Maurice D.Weir, Thomas "Calculus", Pearson, 14th Edition, New Delhi, 2018.
5. Srimanta Paul and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 1st Edition, 2015.

20PHG01	ENGINEERING PHYSICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To know the basic concepts of acoustic and thermal insulation for solving engineering problems
- To make the students effectively to achieve an understanding of mechanics.
- To motivate the students understand the importance of quantum physics.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students to gain knowledge of electromagnetic waves.

COURSE CONTENT:

ACOUSTICS, ULTRASONIC AND THERMAL INSULATION 12

Classification of Sound - decibel - Weber - Fechner law - Sabine's formula - derivation using growth and decay method - Absorption Co efficient and its determination - factors affecting acoustics of buildings and their remedies - Production of ultrasonic– Piezoelectric generator – Detection of ultrasonic waves – Applications – NDT – pulse echo system through transmission and reflection mode - thermal insulation of buildings.

INTRODUCTION TO MECHANICS AND APPLICATIONS 12

Moment of inertia (M.I) - Radius of gyration - M.I of circular disc, solid cylinder, diatomic molecule - K.E of a rotating body — centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum - The concept of gravity – Law of universal gravitation –weigh and weightlessness – Projectile motion – range – height – time.

QUANTUM MECHANICS AND QUANTUM COMPUTING 12

Photons and light waves - Electrons and matter waves - The Schrodinger equation- Time dependent and time independent forms - meaning of wave function - Normalization - particle in an infinite potential well - Introduction to quantum computing - History of quantum computation and quantum information - Quantum bits - Quantum Physics and Computation - Global perspectives - Future directions.

OSCILLATIONS, OPTICS AND LASERS 12

Simple harmonic motion - resonance - waves on a string - standing waves - travelling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference – Michelson interferometer - air wedge experiment. Laser - characteristics - Spontaneous and stimulated emission - population inversion - CO_2-laser, semiconductor laser - applications - holography.

ELECTROMAGNETIC WAVES 12

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation- Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves.

Course Outcome:

At the end of the course student should have the ability to,

CO1: Understand the concepts of acoustic and thermal insulation to solve engineering problems.

CO2: Understand the importance of mechanics and gravitation force for engineering applications.

CO3: Use the basics of quantum physics and computations in engineering field.

CO4: Understand the concepts of wave optics and laser for engineering application.

CO5: Apply the concepts of propagation of electromagnetic waves to solving engineering problems.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO3	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO4	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO5	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Program Articulation matrix

20PHG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

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20CHG01	ENGINEERING CHEMISTRY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To know the basic concepts of electrochemistry for solving engineering problems
- To provide knowledge on batteries and fuel cells
- To impart solid foundation in photochemistry for doing instrumental chemical analysis

- To understand the importance of water treatment for industrial and domestic use that satisfy the requirements and need for the society
- To introduce nanochemistry in order to incorporate it in the field of engineering and technology

COURSE CONTENT:

Electrochemistry

Electrochemical cells – Nernst Equation (Problems), Electrode potential – Representation of a cell -Galvanic cell-Construction and working - Electrodes – Standard Hydrogen Electrode (SHE), Saturated Calomel Electrode (SCE) and Glass Electrode –Electrochemical Series and its applications - Conductometric titrations (Acid -Base Titration).

Batteries

Batteries – Characteristics – Current, Power, Capacity, Classification of batteries – Primary (Dry and Alkaline battery) – Secondary batteries (Lead acid and Nickel – Cadmium) and Flow batteries (Hydrogen – Oxygen and Methanol – Oxygen fuel cells) – Modern batteries – Lithium Ion batteries – Applications.

Photochemistry and Spectroscopy

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photo quenching– mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

Water Treatment

Importance of water – Water sources – Impurities – Carbonate and Non Carbonate Hardness (simple problems) – Potable water and its specifications, Steps involved in treatment of potable water – Disinfection methods – Internal Conditioning (Phosphate, Calgon, Carbonate and Colloidal conditioning method) – External Conditioning – Demineralisation process – Zeolite process– Desalination (Reverse Osmosis).

Nanochemistry

Basics–distinction between molecules, nanomaterials and bulk materials; size–dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization – Scanning Electron Microscope and Transmission Electron Microscope – Principle and instrumentation (block

diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials – medicine, agriculture, electronics and catalysis.

COURSE OUTCOMES

At the end of the course student should have the ability to,

CO1: Understand the basics of electrochemistry and role of reference electrodes.

CO2: Understand the construction, working and applications of various batteries.

CO3: Apply the laws of photochemistry in spectral analysis of chemical substances.

CO4: Identify quality of water for domestic and industrial purposes through analysis of water quality parameters

CO5: Apply basic concepts of Nanoscience and Nanotechnology as a key component in Engineering

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Program Articulation matrix

20CHG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

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20ITG01	PROGRAMMING FOR PROBLEM SOLVING USING C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an introduction to computer hardware. The course further deals with problem solving techniques and their implementations through syntax and semantics of C language.

COURSE CONTENT:

Fundamentals of Computing

Basic concepts of computer organizations, Generation and classification of computers, Number System Representation, Fundamentals of algorithms, Pseudo code, Flow charts.

C Language Fundamentals

Introduction to C programming, Structure of a C program, Compilation and Linking Processes, Character Set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedence of operators, Input-Output Operations, Control Structures, Decision Making, Branching & Looping. Application: Solving Simple Scientific and Mathematical Problems.

Arrays and Strings

Introduction to Arrays, One Dimensional Array, Multidimensional Array. Application: Matrix Operations, Sorting, Searching, Sum of Series and Statistical Problems. String Manipulation, String Arrays. Application: Solving problems using String Functions.

Functions and Pointers

User Defined and Standard Functions, Formal and Actual arguments, Function Prototypes, Parameter Passing, Call-by-Value, Call-by-Reference, Recursion. Application: Math

Functions, Computation of Sine Series, Random Number Generation, Tower of Hanoi and Factorial using Recursive Functions. Pointers, Pointer Variables, Pointer Arithmetic, Passing Parameters by Reference, Pointer to Pointer, Pointers to Functions, Dynamic Memory Allocation. Application: Card shuffling and Dealing Simulation using Pointers.

Structures, Unions and File Handling

Declaration of Structures, Nested Structure, Pointer to Structure, Declaration of Unions, Pointer to Union, Application: Student Records. Storage Classes, Pre-Processor Directives. Files -Types of File Processing: Sequential Access, Random Access. Application: Transaction Processing Program.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply the concepts of algorithm, pseudo code and flow chart to solve problems
CO2: Build control structures to solve problems
CO3: Choose data structures for managing user data
CO4: Apply memory and I/O management constructs of C

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Program Articulation matrix

20ITG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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20MEG02	ENGINEERING WORKSHOP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course aims to make the students understand about various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering by providing practical experience.

COURSE CONTENT:

I. Civil Engineering Practice Lab

Buildings: Study of plumbing and carpentry components of residential and industrial buildings.

PLUMBING WORKS

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.

Hands-on-exercise:

a) Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
b) Demonstration of plumbing requirements of high-rise buildings.

WOOD WORK

Study of the joints in roofs, doors, windows and furniture.
Studying common industrial trusses using models.

Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

II. Mechanical Engineering Practice Lab

Welding & Sheet metal

1. Preparation of arc welding of butt joints, lap joints, tee joints and corner joints.
2. Sign board fabrication by the application of knowledge gained through welding process
3. Forming of simple objects using sheet metal – Trays.

Machining practices

Metal Hammer fabrication using Simple turning, taper turning, drilling taping practice.

Study

Assembling a centrifugal pump
Assembling a blower
Assembling an air conditioner

Demonstration

1. Demonstration on foundry operations.

III. Electrical Engineering Practice Lab

1. Familiarization of wiring tools, lighting accessories of CFL and incandescent lamps, types and selection of Fuse and MCB.
2. Study of various types of wiring systems
   a. Wiring of one lamp controlled by one switch.
   b. Wiring of one lamp controlled by two SPDT Switch and one 3 pin plug socket independently.
   c. Wiring of fluorescent lamp controlled by one switch from panel with MCB.
3. Study of wiring of different household appliances
   a. Iron-Box wiring.
   b. Fan Regulator wiring.
   c. Emergency Lamp wiring.
4. Familiarization with measuring instruments to measure current, voltage and power in AC/DC circuits.

IV. Electronics Engineering Practice Lab

1. Study of Electronic Components and instruments– Resistors, Capacitors, Inductors, Diodes and multimeter.
2. Measurement of AC signal parameters (voltage, period, frequency) using CRO.
3. Measurement of ripple factor of half wave rectifier and full wave rectifier.
4. Study of logic gates –AND, OR, XOR and NOT.
5. Soldering practice using general purpose PCB – Components, Devices and Circuits.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Make various joints in carpentry and select suitable tools for plumbing.

CO2: Fabricate products by selecting suitable tools for machining, metal joining and sheet metal processes.

CO3: Understand the fundamental electrical parameters, protective devices, domestic wiring and accessories.

CO4: Understand the basic principles of electronic components and to apply them in the design of simple electronic circuits on PCB.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Program Articulation matrix

20MEG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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20PHG02	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

COURSE CONTENT:

List of Experiments

1. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
2. Determination of thermal conductivity of a bad conductor using Lee's Disc method.
3. Determination of Young's modulus by non - uniform bending method.
4. Determination of Young's modulus by uniform bending method.
5. Determination of rigidity modulus of a wire and moment inertia of a disc – Torsional pendulum.
6. Determination of dispersive power of prism using spectrometer.
7. Determination of wavelength of a spectral lines using spectrometer grating.
8. Determination of thickness of thin sheet / wire – Air wedge.
9. Determination angle of divergence and wavelength using laser.
10. Determination of the size of micro particles using diode laser with its accessories.
11. Determination of acceptance angle and numerical aperture of an optical fibre.
12. Determination of energy band gap of a semiconductor by using p-n junction diode.

COURSE OUTCOME:

At the end of the course student should have the ability to,

CO1: Determine the modulus of given material, acceptance angle in optical fibre and velocity of sound.

CO2: Determine the thermal conductivity of bad conductors and band gap of a semiconductor.

CO3: Determine the angle of divergence, wavelength of laser and spectral lines.

CO4: Determine the particle size using laser, dispersive power of material and thickness of thin wire.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO2	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO3	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO4	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Program Articulation matrix

20PHG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-

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20ITG02	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course provides guidance to find solutions for engineering problems by developing computer applications using C language.

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Problem Solving Techniques (Algorithm, Pseudo code, Flowcharts).
2. Program using Simple Statements and Expressions.
3. Scientific Problem Solving using Decision Making and Looping.
4. Program using Single and Multidimensional Array.

5. Program using String, Math Inbuilt Functions.
6. Program using User Defined Functions (string & array manipulation) and Storage Classes.
7. Program using Recursive Function.
8. Program using Dynamic Memory Allocation.
9. Program using Structures and Unions.
10. Program using Files.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Find solution methodology using different problem solving techniques.

CO2: Use appropriate data types and control structures for solving a given problem.

CO3: Apply the various concepts of C programming for solving engineering problems.

CO4: Analyse the problem-solving techniques which is appropriate for solving real world problems.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	3	3	-	-	3	-	-	-	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	3	3	-	-	3	-	-	-	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-

Program Articulation matrix

20ITG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	3	3	-	-	3	-	-	-	-	3	-	3	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-

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2. Byron Gottfried S. “Programming in C”, Third Edition, (Indian Edition), Tata McGraw Hill, 2010.
3. Balagurusamy E. “Programming in ANSI C”, Eighth Edition, Tata McGraw Hill Education.
4. Paul Deitel, Harvey Deitel “C How to Program”, Seventh Edition, Pearson Education Asia, 2012.

SECOND SEMESTER SYLLABUS

20HSG02	UNIVERSAL HUMAN VALUES II - UNDERSTANDING HARMONY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. Understand the need for value education.
2. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
3. Understand (or developing clarity) harmony in the human being, family, society and nature/existence strengthening of self-reflection.
4. Development of commitment and courage to act.
5. Infer holistic understanding on professional ethics and humanistic universal order.

COURSE CONTENT:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family):

Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

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

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order,
Competence in professional ethics:
a. Ability to utilize the professional competence for augmenting universal human order
b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
Case studies of typical holistic technologies, management models and production systems,
Strategy for transition from the present state to Universal Human Order:
a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
b. At the level of society: as mutually enriching institutions and organizations , Sum up.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Become more aware of themselves, and their surroundings (family, society, nature)
CO2: Become more responsible in life, and in handling problems with sustainable solutions while keeping human relationships and human nature in mind.
CO3: Have Better critical ability.
CO4: Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO5: Apply what they have learnt to their own self in different day-to-day settings in real life, atleast a beginning would be made in this direction.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	1	-	-	-

Program Articulation matrix

20HSG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**	**1**	-	-	-	-	-	**1**	-	-	-

TEXTBOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1.
2. Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.

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1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

20MHG02	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To introduce the concept of differential equations used in engineering problems.
- To familiarize the concepts of vector calculus arises in many engineering problems.
- To provide the knowledge of analytic functions and its mapping property.
  To acquaint the students with complex and contour integration techniques used in real integrals.
- To develop the students to make use of Laplace transform techniques in ordinary differential equations.

COURSE CONTENT:

SECOND AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS

Linear equations of second and higher order with constant coefficients – Homogenous equations of Euler's and Legendre's type – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients – Applications: Electric circuits, Simple harmonic motions.

VECTOR CALCULUS

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Gauss divergence theorem and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

ANALYTIC FUNCTION

Analytic functions – Necessary and sufficient conditions for analyticity– Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions – Bilinear transformation $w = c + z,\ az,\ \frac{1}{z},\ z^2$.

COMPLEX INTEGRATION

Line integral – Cauchy's Integral theorem– Cauchy's Integral formula – Taylor's and Laurent's series – Singularities – Residues – Cauchy Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

LAPLACE TRANSFORM

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms – Transforms of unit step function and impulse function – Transform of periodic functions. Inverse Laplace transform – Convolution theorem – Initial and final value theorems – Application to solution of linear ordinary differential equations with constant coefficients.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply higher order linear differential equations in simple applications
CO2: Solve problems in the domain of fluid dynamics using vector calculus
CO3: Construct analytic functions and use their conformal mapping property in application problems.
CO4: Apply the Cauchy's integral formula and residue theorem to evaluate real and complex integrals.
CO5: Apply Laplace transform technique to solve linear differential equations.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

Program Articulation matrix

20MHG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2016.
2. Grewal. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2016.

REFERENCES:

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", 1st Edition, Tata McGraw Hill Education, New Delhi, 2016.
2. Srimanta Paul and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 1st Edition, 2015.

3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.

20CSG01	OBJECT ORIENTED PROGRAMMING USING C++	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course provides an insight on the basic principles of Object Oriented Programming using C++ and its applications in real world scenarios.

COURSE CONTENT:

Fundamentals of OOP and C++

Structural versus object-oriented Programming - Elements of object oriented programming-benefits of OOP – Structure of C++ program - Variables - Tokens - Keywords – Identifiers - Type modifiers - Type casting - Input and Output - Data Types and Expressions - Operators - Flow of control - Arrays, Strings and Pointers.

Classes and Objects

Classes and Objects - Class specification: Class Members, Access Specifier, Scope resolution operator- Class Instantiation - Accessing class members- Passing and returning objects - Array of objects – Constructors: Parameterized constructors - Default arguments – Copy Constructor - Constructor overloading, Destructors - new, delete operators - "this" pointer - Friend classes and friend functions.

Overloading and Inheritance

Function overloading - Operator overloading: Overloadable operators - Unary operator overloading - Binary operator overloading, Overloading the Operator Using Friend Function - Inheritance: Base class and derived class relationship - Derived class declaration - Types of inheritance - Member accessibility - Constructors in derived class.

Virtual functions and Generic Programming

Virtual Functions: Need for virtual function - Pointer to derived class objects - Pure virtual functions - Abstract classes – Virtual Destructors, Generic programming with templates: Function templates - class templates

I/O Streams and Exception handling

Streams: Formatted and unformatted data – Manipulators - Files: Opening and Closing a file - File modes - File pointers and their manipulation, Sequential access to a file - Random access to a file - Reading and Writing files, Exception handling: Exception handling constructs - Handling exceptions.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of Object Oriented Programming

CO2: Choose appropriate Object Oriented features for solving various problems

CO3: Develop C++ application for real world scenarios

CO4: Apply the concepts of Exception handling, generic programming and file handling in programmes using C++

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Program Articulation matrix

20CSG021	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	**-**	**3**	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
3. Deitel and Deitel, "C++ How to Program", 10th Edition, Prentice Hall India Learning Private Limited, 2018.
4. Robert Lafore, "Object Oriented Programming in C++", 4th Edition, Pearson India, 2002.
5. Stanley B. Lippman and Josee Lajoie, "C++ Primer", 5th Edition, Pearson Education, New Delhi, 2013.
6. E.Balagurusamy, "Object Oriented Programming with C++", 6th Edition, Tata McGraw Hill, 2013.

20ECG01	ELECTRIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to gain knowledge on the concepts of electric circuits, circuit laws, network theorems, network topology, RLC and coupled circuits

COURSE CONTENT:

Basic Circuit Concepts & Laws

Electrical elements and their classification– Charge, Current, Voltage, Power and Energy– Ohm's law – KCL and KVL–Independent and dependent sources– Series and Parallel circuits– Voltage and current division in Series and Parallel Circuits– Source Transformation –Star to Delta conversion and Delta to Star conversion-Principle of Duality.

Sinusoidal Steady State Analysis

A.C. Single Phase Circuits– Sinusoidal Voltage and Current – RMS Value – Form Factor – Phasor representation of Sinusoidal Voltage–Phasor relationship for R, L, and C, impedance and Admittance, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

Analysis of Electrical Circuits

Mesh and nodal analysis with Voltage and Current source for DC and AC circuits. Theorems: Superposition theorem -Thevenin's theorem - Norton's theorem - Reciprocity and Maximum Power Transfer theorem for AC and DC circuits.

Transients and Resonance in RLC Circuits

Transient response: Response of RL, RC and RLC circuit to DC supply. Resonance: Series Resonance– Parallel resonance–Basic definition of Quality factor & Band-width.

Coupled Circuits and Topology

Introduction to coupled circuits – Dot rule – Self and Mutual inductance – Coefficient of coupling –Magnetically Coupled Circuits - the Linear Transformer - the Ideal Transformer-An introduction to Network Topology-Trees and General Nodal analysis-Links and Loop analysis.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of circuit elements and laws of electric circuits.

CO2: Apply circuit theorems / laws to compute DC and AC circuit parameters.

CO3: Analyze the time and frequency responses of RL, RC and RLC circuits.

CO4: Analyze coupled circuits, duality and network topology.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20ECG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**

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2. W.H.Hayt, Jr J. E. Kemmerly and S. M.Durbin, “Engineering Circuit Analysis”, TMH, Ninth Edition, 2018.
3. Robert L. Boylestad, “Introductory Circuit Analysis”, Pearson Prentice Hall, Thirteenth Edition - Global Edition, 2016.
4. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s Series, Tata McGraw-Hill, New Delhi, Seventh Edition 2013.
5. S.N.Sivanandam “Electric Circuit Analysis”, Vikas Publishing House Pvt. Limited, Second Edition, Reprint 2015.

20EC001	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to gain knowledge on the characteristics and operation of the basic electronic devices such as PN junction diode, Bipolar junction transistors, Field effect Transistors, Power control devices and Display devices.

COURSE CONTENT:

Properties of Semiconductor Materials

Energy band structure of Conductors, Semiconductors, Insulators – Carrier concentration in an intrinsic and extrinsic semiconductors - Mass-Action Law- N type and P Type - Mobility and Conductivity – Charge densities in the semiconductor-Carrier Generation and Recombination - Drift and diffusion currents

PN Junction diodes

PN junction diode – Forward and Reverse bias characteristics – Diode Current equations – Diffusion and drift current densities –Transition or Space charge Capacitances- Diffusion Capacitances – Effect of temperature on PN junction diode – Diode Switching characteristics – Rectifiers- Zener diode – VI characteristics – Zener diode as voltage Regulator- Varactor diode.

Bipolar Junction Transistor

Structure and working of bipolar junction transistor – input and output characteristics of CB, CC and CE configurations – Comparison of CB,CE and CC Configuration, h parameter model - Hybrid-π model — Transistor as a switch – DC and AC load line – operating point – various biasing methods for BJT – Thermal stability.

Field-Effect Transistor

Types of FET - Comparison of FET and BJT - Operation of JFET - Drain and Transfer Characteristics of JFET – FET as a Voltage Variable resistor – JFET parameters -MOSFET - principle of operation -Enhancement and Depletion mode MOSFET – Characteristics of MOSFET.

Special Semiconductor devices

Schottky diode -Tunnel diode- Construction, working and characteristics – SCR- Construction, Two transistor equivalent circuit, Characteristics, Applications- DIAC and TRIAC - Construction, working and characteristics – UJT – Operation, Equivalent Circuit and Applications - Fundamentals of light – LDR, LED – LASER - LCD – Photodiode -Photo transistor – Opto Coupler – Solar cell – CCD – CMOS Sensor.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the properties of semiconductor materials.

CO2: Interpret the characteristics of PN junction diodes, BJTs and FETs.

CO3: Understand the operation and characteristics of Special Semiconductor devices

CO4: Make use of semiconductor devices and transistors in simple electronic circuits

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC001	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-		1	3	-

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20MEG01	ENGINEERING GRAPHICS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

The objectives of this course are to impart knowledge to interpret engineering drawings and to enable the students to communicate the concepts, ideas, and basic designs through graphical representations as per related engineering conventions and standards.

COURSE CONTENT:

Curve Constructions and Orthographic Projection

Lettering – Types of lines – Dimensioning – Conics- Construction of ellipse, parabola and hyperbola by eccentricity method-Construction of cycloid- Construction of involutes of square and circle- Drawing of tangents and normal to these curves. Principles of Orthographic projection – Layout of views Orthographic projection of simple Engineering components using first angle Projection. Drawing of multiple views from pictorial views of objects

Projection of Points, Lines and Plane Surfaces

Projection of points – Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces – Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method

Projection of Solids

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

Projection of Sectioned Solids and Development of Surfaces

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of solids with cut-outs and holes.

Isometric and Perspective Projections

Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders, cones – Perspective projection of simple solids prisms, pyramids and cylinder by visual ray method and vanishing point method.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Interpret and construct geometric entities, orthographic projection of engineering components

CO2: Construct orthographic views of points and straight lines

CO3: Apply orthographic principles to construct views of planes and solids

CO4: Build orthographic projection of section of solids and develop the lateral surfaces of solids

CO5: Develop isometric and perspective projections of solids

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	2	-	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

Program Articulation matrix

20MEG01	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	2	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

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20CHG02	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

- To make the students to understand the basic principles of volumetric analysis
- To impart skills in analysis of various water quality parameters
- To enable the students to gain exposure in corrosion studies
- To familiarize the students with water of crystallization of hydrated compounds and molecular weight determination of polymers
- To develop experimental skills of students through instrumental chemical analysis

COURSE CONTENT:

List of Experiments

1. Estimation of acidity of industrial effluent by conductometric titration.
2. Determination of corrosion rate by weight loss method.
3. Determination of water of crystallization of $CuSO_4.5H_2O$
4. Estimation of hardness of water by complexometric method.
5. Determination of DO content of water sample by Winkler's method.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald Viscometer.
7. Determination of strength of Hydrochloric acid using pH meter.
8. Determination of Alkalinity in the given water sample.
9. Estimation of iron content of the given solution using potentiometer.
10. Conductometric precipitation titration using Barium chloride and Sodium Sulphate
11. Determination of strength of acids in a mixture using conductivity meter.
12. Determination of Chloride content in the given water sample by Argentometric method.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Demonstrate analytical techniques for the quality assessment of domestic and industrial waste water.

CO2: Apply experimental chemistry for the investigation of corrosion related problems in industrial field

CO3: Demonstrate determination of molecular weight of polymeric materials so as to use them for various engineering applications.

CO4: Make use of titrimetric analysis for estimating the amount of metal ions present in unknown substances.

CO5: Analyse the given sample using various instrumental methods.

COs, POs, and PSOs - Articulation matrix

Course Outcom	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Program Articulation matrix

20CHG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

REFERENCES:

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3. Jeffery G. H, and Basset J., "Vogel's text book of quantitative chemical analysis", Prentice Hall, 5th Edition, 2012.

20CSG02	PROGRAMMING IN C++ LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course provides a practical experience on the concepts of Object-Oriented Programming using C++ programming language.

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Programs using Objects and Classes

2. Programs using Constructors and Destructors
3. Programs using friend function & friend class.
4. Programs using Function Overloading
5. Programs to overload unary & binary operators as member function & non-member function
6. Programs using types of inheritance
7. Programs using virtual functions
8. Programs using Function and class templates
9. Programs using Files and Streams
10. Programs using Exception handling

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply the concept related to Classes and Objects in simple programs

CO2: Apply the concepts of polymorphism to achieve enhanced functionalities of functions and operator.

CO3: Deploy inheritance in simple C++ programs

CO4: Design simple applications that support File Processing

CO5: Develop programs that are capable of handling Exceptions

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Program Articulation matrix

20CSG02	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	3	3	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
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20AC001	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	0

COURSE OBJECTIVE:

- To increase public awareness about environmental issues
- To impart knowledge on chemical aspects of the environment
- To collaborate on multidisciplinary teams that apply scientific expertise to characterize and address various environmental problems
- To lay the foundations for active participation of individuals in protection of environment
- To acquire knowledge on population growth and its impact on environment

COURSE CONTENT:

Fundamentals of Environmental Science

Introduction- Definition-environment, Environmental science, Environmental engineering- Components of environment - Atmosphere, lithosphere, hydrosphere and biosphere - types of environment – Natural – man – made - Environmental education- objectives, importance and scope - Need for public awareness.

Chemistry of the Environment

Hydrological cycle- concept of DO, BOD and COD - chemical and photochemical reactions in the atmosphere - ozone chemistry - formation and depletion of ozone layer - acid rain mechanism of formation and effects - Photochemical smog and sulfurous smog. Greenhouse effect, global warming- causes, effects and control measures.

Renewable energy and environment

Introduction - Renewable and non - renewable energy sources - Principles of generation of hydro - power, tidal energy, ocean thermal energy conversion, wind power - wind mill - wind farm geothermal energy and solar energy (solar collectors, photovoltaic modules, solar ponds) - Bioenergy: methods to produce energy from biomass - impact of renewable and non - renewable energy sources on the environment.

Environmental Pollution and control

Introduction - Air pollution – sources - major air pollutants – effects and control - Air Pollution control technologies - cyclone separator and electrostatic precipitator –water pollution – sources - major water pollutants - effects and control of water pollution -waste water treatment - Noise pollution –sources- effects and control- Solid waste management – sources, classification, causes and effects -management and control measures of solid wastes - Hazardous waste management - role of an individual in prevention of pollution.

Human population and the Environment

Population growth - variation among nations - Population explosion – Family Welfare Programme -Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basics of environment and need for environmental education.

CO2: Understand various chemical and photochemical reactions in the environment.

CO3: Select suitable renewable resources for domestic and industrial applications to meet the growing energy demand.

CO4: Understand the role of an individual in environmental pollution control and management.

CO5: Understand about population explosion and its impact on environment.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-

Program Articulation matrix

20AC001	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-

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THIRD SEMESTER SYLLABUS

20MHG03	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes.
- To introduce Fourier series analysis which is central to many applications in engineering.
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

COURSE CONTENT:

UNIT I PARTIAL DIFFERENTIAL EQUATIONS

Formation of PDE by elimination of arbitrary constants and functions – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions ¬¬–Lagrange's linear equation – Solution of second and higher order homogeneous and non-homogeneous linear equations with constant coefficients.

UNIT II FOURIER SERIES

Dirichlet's conditions – Expansion of periodic functions into Fourier series – Change of interval – Fourier series for even and odd functions – Half-range expansions – Root mean square value of a function – Parseval's identity – Harmonic analysis.

UNIT III BOUNDARY VALUE PROBLEMS

Classification of second order linear partial differential equations – method of separation of variables - Solutions of one dimensional wave equation – one dimensional heat equation – Steady state solution of two-dimensional heat equation –Fourier series solutions.

UNIT IV FOURIER TRANSFORM

Statement of Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORM

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues)- Initial and final value theorem– Convolution theorem – Formation of difference equations – Solution of difference equations using Z - transform.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Solve partial differential equations which arise in application problems.

CO2: Construct the functions as an infinite series involving sine and cosine functions.

CO3: Use Fourier series techniques in solving boundary value problems.

CO4: Find Fourier transforms for the given functions.

CO5: Apply Z - transform techniques for solving difference equations in engineering field.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

Program Articulation matrix

20MHG03	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

TEXT BOOKS:

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2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2018.

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20EEG05	ELECTRICAL ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

- To impart knowledge on principles of operation and performance of various electrical machines
- To introduce the concepts of special electrical machines

COURSE CONTENT:

DC Generators:

Construction and working principle of DC generator, EMF and Torque equation- Voltage build up process, critical resistance and critical speed, Characteristics, Types–Shunt, Series and Compound-Applications

DC Motors:

Principle of D. C. motor, Type of motors, Torque equation, Characteristics, Armature reaction and commutation, Starting of D.C. motors, Applications.

Single Phase Transformers:

Construction and principle of single phase transformer, operation at no load and on load, equivalent circuit, losses, efficiency and regulation, all – day efficiency

Induction Machines:

Three-phase induction motors- Principle of operation, construction, emf equation, torque-speed characteristics, starting & speed control, Single phase induction motors- starting, Applications.

Special Machines:

Construction and operation of Stepper Motors – Brushless DC Motors-Switched Reluctance Motors-Applications

List of Experiments

1. Load test and OCC on DC Shunt Generator.
2. Load test on DC shunt Motor
3. Load test on Single Phase Transformer.
4. Speed Control of Three phase slip ring Induction motor
5. Load test on Three Phase Squirrel cage Induction Motor.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the operation of DC machines, transformers, induction and special machines

CO2: Identify the suitable electrical machine for various applications

CO3: Analyze the characteristics of various electrical machines theoretically and practically

CO4: Apply the principle of Electric Machines and special machines to engineering problems

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

Program Articulation matrix

20EEG05	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-

REFERENCES:

1. Nagrath I. J and Kothari D. P, “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, Fourth Edition, 2010.
2. A.K. Sawhney, “A Course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Co, 2015
3. H.S.Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill Education, 2004.
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5. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, “Electric Machinery”, Tata McGraw Hill Books Company, Sixth edition, 2003.

20EC002	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to gain knowledge on the concepts of BJT and FET amplifiers, small and large signal analysis of amplifiers, design and analysis of feedback amplifiers, oscillators, wave shaping and multivibrator circuits.

COURSE CONTENT:

BJT and FET Amplifiers

Small signal analysis of common emitter, common collector and common base amplifiers – Differential amplifiers – CMRR – Darlington Amplifier – Bootstrap technique. Small signal analysis of FET amplifier. Introduction to large signal Amplifiers – Class A, Class B and Class C Power Amplifiers.

Frequency response of Amplifiers

Low frequency response of transistor amplifier – Effect of coupling capacitor on low frequency response analysis of CE, MOSFET CS amplifier and single stage amplifier – Short circuit current gain, cut off frequency – fα fβ, Unity Gain Bandwidth– frequency response of multistage amplifiers.

Feedback Amplifiers

Properties of negative feedback – Basic Feedback Topologies – Feedback amplifiers – Series-Shunt, Series-Series, Shunt-Shunt and Shunt-Series Feedback – Determining the Loop Gain – Stability Problem – Nyquist Plot – Effect of feedback on amplifier poles – Frequency Compensation.

Oscillators

Classification, Barkhausen Criterion – Mechanism for start of oscillation and stabilization of amplitude, General form of an Oscillator, Analysis of LC oscillators – Hartley, Colpitts, Clapp, Franklin, Armstrong, Tuned collector oscillators, RC oscillators – phase shift – Wienbridge – Twin-T Oscillators, Quartz Crystal oscillator frequency stability of oscillators.

Wave Shaping and Multivibrator Circuits

RC & RL Integrator and Differentiator circuits – Storage, Delay and Calculation of Transistor Switching Times – Speed-up Capacitor – Diode clippers and Clampers. Collector coupled and Emitter coupled Astable multivibrator – Monostable multivibrator – Bistable multivibrator – Triggering methods for Bistable multivibrator – Schmitt trigger circuit.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of amplifiers, oscillators and wave shaping circuits.

CO2: Apply the small and large signal models to analyze the BJT amplifiers.

CO3: Analyze the gain in feedback amplifiers and frequency of oscillation in oscillators.

CO4: Design current and voltage feedback amplifiers, LC & RC oscillators, wave shaping and multivibrator circuits for the given specifications.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC002	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory",11th Edition, Pearson, 2017.
2. Jacob. Millman, Christos C.Halkias, "Electronic Devices and Circuits",4th Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2015.
3. Sedra and Smith, "Micro Electronic Circuits"; 6th Edition, Oxford University Press, 2011.
4. David A.Bell, "Electronic Devices and Circuits", 5th Edition , Prentice Hall of India Private Limited, New Delhi, 2012.
5. S. Salivahanan and N. Suresh Kumar "Electronic Devices & Circuits", 4th Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2017.

20EC003	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamentals of Boolean algebra, implementation of combinational logic circuits using logic gates, analysis of sequential logic circuits using flipflops and basics of programmable logic devices.

COURSE CONTENT:

Digital Fundamentals

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1_s and 2_s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

Combinational Logic

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

Synchronous Sequential Circuits

Latches- Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization and state assignment– Design of Counters- Ripple Counters, Ring Counter, Johnson Counter, Shift registers, Universal Shift Register.

Asynchronous Sequential Circuits

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

Memory and Programmable Logic

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - CPLD

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of Combinational logic circuits, Sequential logic circuits and Programmable logic devices.

CO2: Develop the circuits of combinational and sequential logic for the given specifications.

CO3: Develop combinational logic circuits using programmable logic devices.

CO4: Analyze the performance of synchronous and asynchronous sequential logic circuits.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO3	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC003	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Morris Mano M. and Michael D. Ciletti, "Digital Design", 6th Edition, Pearson Education, 2018.
2. Donald P Leach, Albert Paul Malvino, Goutam Saha, "Digital Principles and Applications", McGraw-Hill Education, Eighth Edition, 2014
3. John F. Wakerly, "Digital Design Principles and Practices", 5th Edition, Pearson Education, 2018.
4. Charles H. Roth, Larry L Kinney, "Fundamentals of Logic Design", 7th Edition – CL Engineering, 2019.
5. Donald D. Givone, "Digital Principles and Design", Tata McGraw Hill, 2017.

20EC004	ELECTROMAGNETIC FIELDS AND WAVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamental concepts in electric and magnetic fields, static electric and magnetic fields, capacitance and inductance of different geometry, Maxwell's equation, Poynting vector, Wave propagation in different mediums, normal and oblique incidence.

COURSE CONTENT:

Static Electric Field

Coordinate Systems, vector algebra, gradient, divergence, curl, Coulombs law, Electric field intensity for point, line, surface and volume charge distributions, Electric flux density, Gauss law and its applications, Gauss divergence theorem, Absolute electric potential and potential difference, electric dipole, electrostatic energy and energy density.

Steady Magnetic Field

Biot-Savart Law, Magnetic field intensity for straight and circular conductors, Ampere's circuital law, point form of Ampere's circuital law, Stokes theorem, magnetic flux and magnetic flux density, scalar and vector Magnetic potentials, Force and torque on a closed circuit.

Electric and Magnetic Materials

Current and current density, continuity equation, resistance of a conductor, Capacitance, Polarization, Parallel plate, Coaxial and Spherical capacitances, Method of images, nature of magnetic materials, magnetization and permeability, self and mutual inductances, inductance

evaluation for solenoid, toroid, coaxial cables and transmission lines, energy stored in magnetic fields, boundary conditions.

Electromagnetic Waves

Maxwell's equations in point and integral forms, Propagation of plane EM wave in free space, lossy dielectric, perfect dielectric and good conductor, impedance of conducting medium, skin depth, Poynting vector and Poynting Theorem.

Wave Reflection

Plane wave in arbitrary direction, plane wave at dielectric interface, reflection and refraction from dielectric interface, total internal reflection, wave polarization at media interface, Brewster angle, Electromagnetic waves at conducting boundaries.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of electric and magnetic fields under static and time varying conditions.

CO2: Apply Gauss law and Ampere's law to determine electric and magnetic fields respectively for elements of different geometry.

CO3: Determine capacitance and inductance for various geometry.

CO4: Analyze Maxwell's equations and Poynting vector and also determine EM wave parameters for the different media.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC004	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. William H Hayt and John A Buck, "Engineering Electromagnetics", 9th Edition, Tata McGraw-Hill, 2020.
2. Mathew N.O. Sadiku, "Principles of Electromagnetics", 6th Edition, Oxford University Press, 2015.
3. Jordan E.C, "Electromagnetic Waves and Radiating Systems", 2nd Edition Prentice Hall of India, 2015.
4. David K Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson Education, 2018.
5. Aziz Inan, "Engineering Electromagnetics and Waves", 2nd Edition, Pearson Education, 2019.

20EC005	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

This course will enable the students to construct and verify the characteristics of bipolar junction transistors (BJT) in common emitter configuration and also to design and implement electronic circuits such as amplifiers, wave shaping circuits and oscillators using BJT.

COURSE CONTENT:

List of Experiments

1. Input-Output characteristics of BJT CE Configuration.
2. Frequency Response of CE Amplifier with different biases.
3. Design of Differential Amplifier using BJT.
4. Design of Darlington Amplifier using BJT.
5. Design of Class B Complementary Symmetry Power Amplifier.
6. Square wave generator using BJT multivibrators.
7. Design and testing of Clippers.
8. Simulation of MOSFET Common Source Amplifier.
9. Simulation of Clampers.
10. Simulation of RC phase shift and Colpitt's Oscillators using BJT.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Analyze the characteristics of BJT in Common Emitter configuration.

CO2: Analyze the frequency response of BJT and MOS amplifiers.

CO3: Analyze the performance of multistage amplifiers, power amplifiers and clippers.

CO4: Build and analyze amplifiers, clampers and oscillators through simulation.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO2	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC005	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory",11th Edition, Pearson, 2017.
2. Jacob. Millman, Christos C.Halkias, "Electronic Devices and Circuits",4th Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2015.
3. Sedra and Smith, "Micro Electronic Circuits"; 6th Edition, Oxford University Press, 2011.
4. David A.Bell, "Electronic Devices and Circuits", 5th Edition , Prentice Hall of India Private Limited, New Delhi, 2012.
5. S. Salivahanan and N. Suresh Kumar "Electronic Devices & Circuits", 4th Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2017.

20EC006	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to construct and experiment the working of logic gates, flipflops, combinational logic circuits, sequential logic circuits and also to analyze the operation of circuits using spice simulation.

COURSE CONTENT:

1. Verifications of logic gates and implementation of Boolean expressions using logic gates.
2. Design and Implementation of arithmetic circuits using logic gates
3. Design and implementation of Code Converters using Logic Gates.
4. (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
5. Design and implementation of Multiplexers and De-multiplexers using logic gates.
6. Design and implementation parity generator/ checker using logic gates.
7. Construction and verification of D&T flip-flops.
8. Design and implementation of Shift registers.
9. Design and Implementation of 3 Bit Synchronous Up/Down Counter.
10. Construction and verification of 4-bit ripple counter and Mod 10/Mod 12 Ripple Counter.
11. Simulation of Boolean expressions with logic gates using HDL.
12. Simulation of Encoder and Decoder using HDL.
13. Simulation of Shift Registers with D-Flipflop using HDL.
14. Simulation of Synchronous Up/Down Counter using HDL.
15. Simulation of Ripple Counter using HDL.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Demonstrate the working of logic gates and flip-flops..

CO2: Analyze the operation of Combinational and Sequential circuits through simulation using HDL.

CO3: Design, construct and test the working of Combinational logic circuits using logic gates.

CO4: Design, construct and test the working of Sequential logic circuits using flip-flops.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	1	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	1	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC006	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Morris Mano M. and Michael D. Ciletti, “Digital Design”, 6th Edition, Pearson Education, 2018.
2. Donald P Leach, Albert Paul Malvino, Goutam Saha, “Digital Principles and Applications”, McGraw-Hill Education, Eighth Edition, 2014
3. John F. Wakerly, “Digital Design Principles and Practices”, 5th Edition, Pearson Education, 2018.
4. Charles H. Roth, Larry L Kinney, “Fundamentals of Logic Design”, 7th Edition – CL Engineering, 2019.
5. Jayaram Bhaskar, “A VHDL Primer”, 3rd Edition, Pearson Education, 2015.

FOURTH SEMESTER SYLLABUS

20MHG05	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To learn the classifications of random processes with emphasis on stationarity of various orders along with strict sense stationarity, wide-sense stationarity and ergodicity.
- To understand the concepts of correlation functions and power spectral density and their properties.
- To be able to apply the knowledge gained so far with respect to linear systems with random inputs.

COURSE CONTENT:

Probability and Statistical Distributions

Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variable – Moments – Moment generating functions – Binomial – Poisson – Uniform – Exponential – Normal distributions – Functions of a random variable.

Two-Dimensional Random Variables

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables – Central limit theorem (without proof) – Problems.

Random Processes

Classification – Stationary Processes – Markov process – Markov chain – Poisson process – Random telegraph process

Correlation and Spectral Densities

Auto correlation – Cross correlation – Properties – Power spectral density – Cross spectral density – Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function.

Linear Systems with Random Inputs

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply the concepts of random variables and probability distributions to solve problems in engineering field.

CO2: Familiarize the concepts of two-dimensional random variables and apply them in the field of engineering.

CO3: Apply the concepts of random processes to solve practical engineering problems.

CO4: Analyze and apply the properties of auto, cross correlation and system transfer function in engineering field.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3

Program Articulation matrix

20MHG05	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3

TEXT BOOKS:

1. Oliver C. Ibe “Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition, 2014.
2. Peyton Z. Peebles, "Probability, Random Variables and Random Signal Principles", Tata Mc Graw- Hill, 4th Edition, 2017.

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1. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", John Wiley & Sons, 3rd Edition, 2014.
2. Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rdIndian Edition, 2012.
3. Veerarajan. T, “Probability, Statistics and Random Processes”, 3rd Edition, Tata McGraw-Hill Education, 2013.

20EC007	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the characteristics and theory of operational amplifier IC 741, applications of opamp, operation of analog multipliers, PLL, ADC, DAC, Waveform generators and few special function ICs.

COURSE CONTENT:

Basics of Operational Amplifiers

Operational Amplifier: Fundamental block diagram - Symbol - Characteristics of an Ideal Operational Amplifier - Circuit schematic of μA741- Operational Amplifier Characteristics: DC and AC performance characteristics - Open loop gain - CMRR - Slew rate and transfer Characteristics - Input bias and Output offset voltages - Offset compensation techniques - Frequency response characteristics - Stability - Limitations - Frequency compensation.

Applications of Operational Amplifiers

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, Adder, Subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper.

Analog Multiplier and PLL

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell –Analog multiplier ICs and their applications, Operation of the basic PLL, Voltage Controlled Oscillator (VCO), Monolithic PLL IC 565 – basic block diagram and operation, capture range and lock range, applications of PLL IC 565.

Analog to Digital and Digital to Analog Converters

Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2R Ladder type, Voltage Mode and Current Mode types – switches for DAC, sample

and hold circuits, A/D Converters – specifications – Flash, Successive Approximation, Single Slope, Dual Slope.

Waveform Generators and Special Function ICs

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, Timer IC 555 – functional diagram, Monostable and Astable operation, applications, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basic concepts of op-amp, analog multipliers, A/D and D/A converters, PLL, waveform generators and IC voltage regulator

CO2: Develop circuits using opamp in linear and nonlinear applications.

CO3: Develop waveform generation circuits using opamp and 555 Timer IC for the given specifications.

CO4: Analyze the performance of opamp, analog multipliers, IC Voltage regulators, PLL, ADC and DAC.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO3	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC007	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Roy Choudary D. and Shail B. Jain, "Linear Integrated circuits", 5th Edition, New Age International Publishers, 2018.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, PHI, 2015.
3. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", 4th Edition, TMH, 2016.
4. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.

20EC008	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to gain knowledge about the various types of signals and systems, analysis of continuous and discrete time signals and analysis of Linear Time Invariant systems.

COURSE CONTENT:

Classification of Signals and Systems

Basic Continuous Time (CT) Signals, Basic Discrete Time (DT) Signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Unit Impulse and Unit Step Functions, Signal Classification –Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals – CT systems and DT systems – Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable, Introduction to Linear Time invariant Systems.

Analysis of Continuous Time Signals

Fourier and Laplace Transforms in CT Signal Analysis – Properties, Region of Convergence (ROC) in LT, Relationship of LT with Fourier Transform, Spectrum of CT signals (Amplitude & phase spectra).

Linear Time Invariant (LTI) Continuous Time (CT) Systems

Differential Equation- Impulse response - convolution integrals- - Fourier and Laplace transforms in Analysis of CT systems.

Analysis of Discrete Time Signals

Introduction to Baseband Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties, Region of Convergence (ROC) in LT.

Linear Time Invariant (LTI) Discrete Time (DT) Systems

Difference Equations-Impulse response - Convolution sum- Discrete Fourier and Z Transform in Analysis of DT systems.

COURSE OUTCOMES:

At the end of the course student should have the ability to, ability to,

CO1: Understand the various types of signals and systems.

CO2: Analyze continuous time LTI systems using Fourier and Laplace Transform.

CO3: Analyze discrete time LTI systems using Z transform and Discrete Time Fourier Transform.

CO4: Classify the signals and systems used in transmission applications and to perform the analysis of the system.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC008	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. Alan V. Oppenheim, Alan S. Wilsky, S. Hamid Nawab, "Signals and Systems", 2nd Edition, Prentice Hall India, 2015.

2. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”, 4th Edition, PHI, 2014.
3. B.P. Lathi, “Signal Processing and Linear Systems”, 3rd edition, Oxford University Press, Incorporated, 2017.
4. Hwei Hsu, “Signals and systems”, Schaum's outlines, 4th Edition, Tata McGraw-Hill Co Ltd, 2019.
5. M.J.Roberts, “Signals and Systems, Analysis Using Transform Methods and MATLAB”, 3rd Edition , Tata McGraw Hill (India), 2019.

20EC009	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn about the transmission line parameters, characteristics of High Frequency Transmission lines, impedance matching techniques, Smith chart, and characteristics of waves between parallel plates and in waveguides.

COURSE CONTENT:

Transmission Lines Parameters

A line of cascaded T sections- General solution of transmission lines- Physical significance of the equations, infinite line, wavelength, velocity of propagation, distortion line- reflection on a line not terminated in Zo, reflection coefficient, open and short circuited lines, insertion loss, input impedance, transfer impedance.

The Line at Radio Frequency

Parameter of the open wire line and coaxial line at RF- Line constants for dissipation less line, voltages and currents on the dissipation less line, standing waves, input impedance of open and short circuited lines- power and impedance measurement on lines.

Line Impedance Matching Techniques and Smith Chart

λ/2, λ/4, λ/8 line- Quarter Wave line impedance matching- single and double stub matching, Smith chart and its applications, problem solving using Smith chart, numerical tools.

Parallel Planes and Rectangular Waveguide

General solutions for TE and TM waves, Waves between parallel plates of perfect conductors- Velocities of wave propagation- Attenuation in parallel plate waveguide, Wave impedance of TE and TM waves in a parallel plate waveguide, Characteristics of TE and TM waves – Impossibility of TEM waves in rectangular waveguides, Dominant mode, Wave impedances of TE and TM waves, Characteristic impedance of a waveguide – Attenuation factor, Excitation of various modes.

Circular Waveguides and Cavity Resonators

Bessel functions, TE and TM modes in circular waveguides- wave impedances, dominant mode, excitation of mode- Microwave cavity resonators, rectangular and Circular cavity resonators- Q factor of a rectangular cavity resonator for the TE101 mode.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of wave propagation in Transmission line and waveguide.

CO2: Analyze the wave propagation in transmission line and waveguide.

CO3: Determine various line parameters for the specified transmission line.

CO4: Determine waveguide parameters for the different modes of propagation.

CO5: Design stub and quarter wave line matching circuits.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO5	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC009	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Ryder J.D, "Networks, Lines and Fields", 2nd Edition, Prentice Hall of India, New Delhi, 2015.
2. Jordan E.C, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2015.

3. B. Somanathan Nair, “Transmission Lines and Wave guides”, Sanguine Technical Publishers, 2006.
4. G.S.N Raju, “Electromagnetic Field Theory and Transmission Lines”, Pearson Education, 1st Edition, 2005.
5. W.H.Hayt, ”Engineering Electromagnetics”, 9th edition, McGraw Hill, 2020.

20EC010	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to gain knowledge about the architecture, operation, addressing modes and instruction set of 8086 microprocessor and 8051 microcontroller, programming using 8086 and 8051, and I/O interfacing.

COURSE CONTENT:

8086 Processor Architecture

Introduction to microprocessors – 8086 Architecture – Programmable registers, address and data busses, memory interfacing, Pin diagram descriptions – signals, Minimum mode and Maximum mode.

8086 Programming

Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, control transfer instructions, process control instructions – Assembler directives – Assembly Language programs for logical, arithmetic, delay and interrupt programming.

I/O Interfacing

Peripheral Interface using 8255 in I/O and BSR mode – 8279 Keyboard/Display controller – 8251 USART – Timer/Counter (8253) – ADCs and DACs –Programmable DMA Controller (8257) - Power and energy consumption of processor

8051 Microcontroller

Architecture of 8051 – Register set – I/O Pins, Ports and Circuits – Instruction set – Addressing modes – Assembly language programs for arithmetic and Logical operations.

Interfacing using 8051 Microcontroller

Programming 8051Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – Stepper Motor Interfacing – Application of 8051 in power optimization – Case study of MSP430.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Interpret the architectures of 8086 microprocessor and 8051 microcontrollers.

CO2: Develop assembly language program for 8086 microprocessor using appropriate addressing modes and instruction set.

CO3: Develop assembly language program for 8051 microcontroller using appropriate addressing modes and instruction set.

CO4: Analyze the functional usage of microprocessor and microcontroller systems along with interfacing devices for embedded system-based applications.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO3	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC010	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Doughlas V. Hall, "Microprocessors and Interfacing, Programming and Hardware",3rd Edition, TMH, 2017.
2. A.K. Ray, K. M. Bhurchandi, "Advanced Microprocessor and Peripherals",3rd Edition, Tata McGraw-Hill, 2017.
3. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2013.
4. Subrata Ghoshal, "8051 Microcontrollers: Internals, Instructions, Programming &Interfacing", 2nd Edition, Pearson education, 2014.
5. John Paul Shen, Mikko H. Lipasti "Modern Processor Design: Fundamentals of Superscalar Processor", Waveland Press, Inc., 2013.

20EC011	INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to focus on analysis of operational amplifier and design, simulate and test active filters, multivibrators, comparators, data converters and voltage regulator circuits.

COURSE CONTENT:

List of Experiments

1. Design and testing of inverting, non-inverting amplifiers, adders and Subtractor using Opamp IC 741.
2. Design and testing of Voltage Comparator using LM339.
3. Design and testing of Integrator and Differentiator using Opamp IC 741.
4. Design and analysis of RC phase shift oscillator using Opamp IC 741.
5. Design and analysis of Waveform generators using Opamp IC 741.
6. Design and testing of multivibrators using 555 Timer IC.
7. Design and testing of voltage regulators using 723 IC.
8. Design and testing of Voltage to frequency converter using VCO-IC 566.
9. Design and testing of frequency multiplier using PLL-IC 565
10. Spice simulation of integrator, differentiator using Opamp IC 741.
11. Spice simulation of Active filters using Opamp IC 741.
12. Spice simulation of Monostable Multivibrators using Timer IC.
13. Spice simulation of D/A and A/D converters.
14. Spice simulation of LC Oscillators

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Test and analyze the characteristics of operational amplifier.

CO2: Test and analyze the voltage regulators, oscillator, waveform generators.

CO3: Design, simulate and test active filters, multivibrators, data converters.

CO4: Test and analyze special purpose integrated circuits.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO2	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	1	-	2	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC011	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Roy Choudary D. and Shail B. Jain, "Linear Integrated circuits", 5th Edition, New Age International Publishers, 2018.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, PHI, 2015.
3. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", 4th Edition, TMH, 2016.
4. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.

20EC012	MICROPROCESSOR & MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to acquire practical skills in assembly level programming by conducting experiments using 8086 microprocessor & 8051 Microcontroller and also interfacing with peripheral devices.

COURSE CONTENT:

List of Experiments (using 8086 Microprocessor, 8051 Microcontroller and MASM):

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion
4. Floating point operations, sorting and searching
5. Counters and Time Delay
6. Traffic light controller
7. Stepper motor control
8. Key board and Display
9. Assembly Language Programs using Macros and procedures
10. A/D and D/A interface and Waveform Generation

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Write Assembly Language Programs using 8086 microprocessor and 8051 microcontrollers.

CO2: Demonstrate the interfacing of I/O devices using 8086 microprocessor.

CO3: Demonstrate the generation of waveforms using 8086 microprocessor.

CO4: Develop real time applications using 8086 microprocessor and 8051 microcontroller.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO2	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	1	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	1	-	2	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC012	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Doughlas V. Hall, "Microprocessors and Interfacing, Programming and Hardware",3rd edition, TMH, 2017.
2. A.K. Ray, K. M. Bhurchandi, "Advanced Microprocessor and Peripherals", 3rd Edition, Tata McGraw-Hill, 2017.
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4. Subrata Ghoshal, "8051 Microcontrollers: Internals, Instructions, Programming &Interfacing", 2nd Edition, Pearson education, 2014.
5. John Paul Shen, Mikko H. Lipasti "Modern Processor Design: Fundamentals of Superscalar Processor", Waveland Press, Inc., 2013.

FIFTH SEMESTER SYLLABUS

20HMG05	PROFESSIONAL PRACTICE AND ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE:

This course will enable the students to understand Engineering Ethics and Human values, Moral and Social Values, Loyalty and the rights of others.

COURSE CONTENT:

Human Values

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

Engineering Ethics

Senses of Engineering Ethics– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

Engineering as Social Experimentation

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

Safety, Responsibilities and Rights

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Global Issues

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development –Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors –Moral Leadership –Code of Conduct – Corporate Social Responsibility.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Remember ethical principles, theories and human values.

CO2: Understand social experimentation, safety, responsibilities and rights in the Society.

CO3: Understand the global issues with knowledge on Environmental and computer ethics.

CO4: Apply the principles of social experimentation in Engineering.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	1	-	-	-	-	-	1	1	-
CO2	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	1	-	2	-	1	-	-	-	-	-	1	1	-
CO3	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	1	-	2	-	1	-	-	-	-	-	1	1	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	3	-	2	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20HMG05	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	3	-	2	-	1	-	-	-	-	-	1	3	-

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1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata Mc Graw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India,New Delhi, 2004.
3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

20EC013	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn about discrete-time convolution, difference equations, Discrete Fourier transform and Fast Fourier transform, digital network structures for implementation of both recursive and non-recursive digital filters, Finite word length effects in digital filters and the concepts of Multirate Signal Processing.

COURSE CONTENT:

Discrete Fourier Transform

DFT– Properties of DFT- Circular Convolution - Efficient computation of DFT– FFT Algorithms-Radix 2 DIT–FFT and DIF–FFT, use of DFT in linear filtering.

Design of Infinite Duration Impulse Response Filters

Analog filters–Butterworth and Chebyshev Type I–Transformation of analog filters into digital filters using approximation of derivatives, Impulse invariant method and Bilinear transformation method–preparing–Realization structures for IIR filters–direct, cascade and parallel forms.

Design of Finite Duration Impulse Response Filters

Windowing techniques for design of linear phase FIR filters: Rectangular, Hamming, Hanning – FIR filter design using Frequency sampling method–Comparison of FIR and IIR filters.

Finite Word Length Effects

Quantization noise – quantization noise power – Fixed point and floating point number representations – Comparison – truncation and rounding errors – quantization error – coefficient quantization error–product quantization error – limit cycle oscillations – dead band – overflow error.

Multirate Signal Processing

Introduction to Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor. Applications of Multirate signal processing.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of Discrete Fourier Transform and multirate signal Processing.

CO2: Apply transforms for designing digital filters**.**

CO3: Analyze the finite Word length effect on filters.

CO4: Design Infinite Impulse Response filters.

CO5: Design Finite Impulse Response filters**.**

CO6: Design infinite and finite duration impulse response filters for signal processing applications

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO5	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO6	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC013	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", 4th Edition, Pearson Education, 2014.
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 3rd Edition, Prentice Hall India, 2015.
3. Mitra S.K. "Digital Signal Processing - A Computer based approach", 4th Edition, Tata McGraw Hill, 2015.

4. P.Ramesh Babu, “Principles of Digital Signal Processing”, Scitech Publications, 6th Edition, 2017.
5. R.S.Kelar, M. Kulkarni and Umesh Gupta “Digital Signal Processing”, Wiley Publications, 2019.

20EC014	ANALOG COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the concepts of analog modulation/demodulation, noise theory, noise in continuous wave modulation systems, sampling and pulse modulation techniques.

COURSE CONTENT:

Amplitude Modulation

Basic blocks of Communication System – Need for Modulation – Amplitude Modulation – Time and Frequency domain description, power relations in AM waves– Methods of generation and detection of AM, DSB-SC, SSB-SC and VSB-SC signals – Comparison of AM systems – FDM – AM Broadcast transmitter – Superheterodyne Receiver and its characteristics.

Angle Modulation

Frequency and Phase modulation – Single tone, narrow band and wideband FM – Transmission Bandwidth – Generation and detection of FM signal – FM Radio Receiver.

Noise Theory

Noise sources and types – Noise figure and noise temperature – Noise equivalent bandwidth –Friis formula –Noise in cascaded systems- Narrow Band Noise and its representations.

Noise in CW modulation systems

Introduction – Receiver model – Noise in AM receivers, Noise in DSB-SC receivers, Noise in SSB receivers – Threshold effect – Noise in FM receivers – FM threshold effect – Capture effect – Pre-emphasis and De-emphasis in FM.

Sampling and Pulse Modulation Techniques

Low pass sampling theorem – Aliasing-Types of sampling- Signal Recovery through holding - Pulse Modulation techniques - PAM, PPM and PWM-Generation and detection.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the principles of amplitude and frequency modulation techniques and noise theory

CO2: Understand the process of sampling and different pulse modulation schemes.

CO3: Apply the mathematical relationships to calculate the performance parameters in AM and FM systems.

CO4: Analyse the performance of AM and FM receivers in the presence of channel noise.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC014	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. Simon Haykin, "Communication Systems", John Wiley & sons, 5th Edition, 2011.
2. Herbert Taub & Donald L Schilling – "Principles of Communication Systems",4th Edition, Tata McGraw Hill, 2017.
3. George Kennedy and Bernard Davis, "Electronic Communication Systems", 6th Edition, Tata McGraw Hill, 2017.
4. J.G.Proakis, M.Salehi, "Communication Systems Engineering", 2nd edition, Pearson Education ,2015.
5. Wayne Tomasi, "Electronic Communications Systems: Fundamentals through Advanced Telecommunications Series", 6th Edition, Pearson, 2015.

20EC015	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn about the modeling of physical systems, transient and frequency response analysis of feedback systems using different techniques, analysis of the behavior of unity feedback systems and design of suitable controller/compensator to meet the desired specifications without sacrificing stability.

COURSE CONTENT:

Control System Modeling

Terminology and Basic structure of Control system-open loop and closed loop systems – Mathematical modelling of Mechanical and electrical systems– Block diagram reduction and Signal flow graph techniques.

Time Response Analysis

Transient and Steady state response of type 0 and type 1 first and second order systems – Impulse and step response - Steady state and dynamic error – P-PD-PI-PID controllers

Frequency Response Analysis

Frequency domain specifications –Frequency response of standard second order system– Polar plot – Bode plot – Assessment of relative stability – Closed loop frequency response from open loop response, Performance criteria – Lag/Lead compensator design using bode plots.

Stability Analysis

Necessary and sufficient conditions for BIBO stability – Absolute, Marginal and Relative stability – Routh stability criterion, Nyquist Stability Criterion, Root locus construction – Effect of pole-zero addition.

State Variable Analysis

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations – Concepts of Controllability and Observability – State space representation for Discrete time systems.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.

CO2: Analyze the time response of different systems and to determine their steady state error.

CO3: Formulate different types of analysis in frequency domain to clarify the nature of stability of the system.

CO4: Analyze the stability of various systems using Routh-Hurwitz, Root locus and Nyquist Stability Criterion.

CO5: Evaluate the concepts of controller and compensator to meet the desired specifications.

CO6: Develop state space models and to determine the observability and controllability of CT and DT systems.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO5	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO6	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC015	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	3

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3. J.Nagrath and M.Gopal, "Control System Engineering", 4th Edition New Age International Publishers,2017.

4. Norman S. Nise, “Control System Engineering”, 6th Edition, Wiley India, 2018.
5. K. Ogata, “Modern Control Engineering”, 5th Edition, PHI, 2015.

20EC016	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

This course will enable the students to acquire skills in MATLAB programming by writing MATLAB codes for the generation of sequences, Linear Convolution, Circular Convolution, FIR and IIR filter operations and to implement the programs using DSP processor.

COURSE CONTENT:

Experiments using MATLAB

1. Generation of signals.
2. Linear and Circular convolution of two sequences.
3. Calculation of FFT of a signal
4. Auto correlation and Cross Correlation
5. Design of FIR filters (LPF/HPF/BPF/BSF).
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF).
7. Decimation and Interpolation

Experiments using DSP Processor

8. Study of architecture of Digital Signal Processor, Waveform generation, Implementation of FIR filter
9. Linear Convolution
10. Circular Convolution

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of generating various types of signals.

CO2: Apply the concepts of hardware structure of DSP processors to implement Convolution, FIR and IIR Filter operations.

CO3: Analyze the operation of FIR and IIR filters using MATLAB.

CO4: Analyze Convolution, Discrete Fourier Transform operations using MATLAB.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC016	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata Mc Graw Hill, 2015.
2. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, 4th Edition, Pearson Education, 2014.
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4. Venkataramani B, and Bhaskar M, “Digital Signal Processors: Architecture, Programming & Applications”, Tata McGraw Hill, New Delhi, 2011.
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20EC017	ANALOG COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to learn the practical aspects of amplitude modulation, angle modulation, Sampling and Pulse modulation techniques through conduct of experiments and simulations.

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Generation/Detection of Amplitude Modulation.
2. Generation/Detection of DSB-SC using IC MC1496.
3. Generation/Detection of Frequency Modulation.
4. Frequency response of Pre-emphasis and De-emphasis circuits.
5. Performance characteristics of AM Receiver.
6. Generation of PAM, PPM, PWM using 555 Timer IC.
7. Verification of Sampling theorem and Signal Recovery through holding
8. Verification of TDM and FDM techniques.
9. Simulation of Amplitude modulation and demodulation using MATLAB.
10. Simulation of Frequency modulation and demodulation using MATLAB.
11. Performance analysis of AM and FM systems in the presence of noise using MATLAB.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply the principles of analog modulation and demodulation techniques.

CO2: Analyze the performance of AM and FM systems through conduct of experiments.

CO3: Analyze the performance of pulse modulation systems through conduct of experiments.

CO4: Analyze the performance of analog modulation systems through simulations.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC017	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. G. Kennedy, Bernard Davis, “Electronic Communication Systems”, Tata McGraw Hill, 5th Edition, Tata McGraw Hill, 2012.
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SIXTH SEMESTER SYLLABUS

20EC018	DIGITAL VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the principles and properties of MOS transistors, implementation of combinational and sequential logic circuits at circuit level using MOSFETs, realization of arithmetic building blocks and the implementation of digital VLSI circuits using Xilinx and ACTEL FPGA.

COURSE CONTENT:

MOS Transistor Principle

NMOS and PMOS transistor operations, MOS DC Equations, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles CMOS inverter, Second Order Effects, propagation delays, Stick diagram, Layout diagrams.

Combinational Logic Circuits

MOSFETs as switches, Basic Logic Gates in CMOS, Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation, Low power design principles.

Sequential Logic Circuits

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits.

Arithmetic Building Blocks

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, Multipliers, dividers, Barrel shifters, speed and area tradeoff.

Implementation Strategies

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Xilinx and ACTEL FPGA.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1 Apply the basic concepts of MOS circuits for the realization of various building blocks used in digital VLSI design.

CO2 Understand MOS circuits, data path circuits for the design of digital VLSI circuits.

CO3 Design CMOS based combinational and sequential logic circuits for low power applications

CO4 Analyze the performance of MOS circuits, data path circuits for the custom design and standard cell design of digital VLSI circuits

CO5 Choose appropriate architecture for implementation strategies and to design the transistor level circuits in realization of various arithmetic building blocks.

CO6 Design and implement VLSI based electronic system.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO5	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO6	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC018	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

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5. R.Jacob Baker, Harry W. LI., David E. Boyce, “CMOS Circuit Design, Layout and Simulation”, IEEE Press series on Microelectronic Systems Book 19, 2011.

20EC019	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the concepts of information theory, waveform coding techniques, various baseband and bandpass transmission schemes and error control coding techniques

COURSE CONTENT:

Information Theory

Measure of information – Entropy – Source coding theorem – Discrete memoryless channels–BEC, BSC – Mutual information – Channel capacity – Shannon Hartley law- Source Coding Techniques - Shannon-Fano coding, Huffman Coding.

Waveform Coding

Review of Sampling Process, Quantization - Uniform & Nonuniform quantization - quantization noise - PCM –DPCM - Delta Modulation - ADPCM & ADM principles- Linear Predictive Coding -TDM.

Baseband Transmission

Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ - Manchester- ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding – Eye pattern – Equalization-Matched filter Receiver and Correlative Receiver.

Digital Modulation Scheme

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - - Structure of non-coherent receivers - Principle of DPSK- Carrier synchronization-Introduction to Spread Spectrum techniques.

Error Control Coding

Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes-Viterbi Decoder.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the principles of information theory, waveform coding and modulation schemes in digital communication systems.

CO2: Apply source coding schemes and digital modulation techniques for a given communication system.

CO3: Analyze the performance of digital modulation schemes in the presence of channel noise**.**

CO4: Develop baseband transmission schemes, pass band transmissions schemes and error control coding schemes.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC019	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	**-**	**3**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**

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1. S. Haykin, "Digital Communication Systems", John Wiley, 2018.
2. Herbert Taub & Donald L Schilling – "Principles of Communication Systems", 4th Edition, Tata McGraw Hill, 2017.
3. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2013.
4. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press 2017.
5. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2013.

20EC020	ANTENNAS AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the radiation characteristics of different types of antenna, different types of propagation of radio waves at different frequencies, analysis of antenna parameters for different types of antennas and array.

COURSE CONTENT:

Radiation Principles and Radiating Wire Structures

Concept of scalar and vector potentials – Retarded vector potentials, Radiation from an elementary dipole, Half wave dipole and Quarter Wave monopole antenna. Antenna parameters: Radiation pattern, Beam width, Gain, Directivity, Effective height, Effective aperture, Bandwidth, Polarization and Antenna Temperature – Helical antenna, Log periodic antenna.

Antenna Arrays

Two element array – uniform linear array – Broadside and End fire array – Direction of maxima, minima, Beamwidth, HPBW, Visible Region, Directivity, method of pattern multiplication, binomial array, Phased arrays, Adaptive arrays and Smart antennas. Dolph-Chebychev array.

Aperture and Lens Antennas

Radiation from Huygen's source, Radiation from rectangular aperture - Directivity, Beam width and effective area, E plane horn, H Plane Horn-Pyramidal Horn - Reflector antennas-Paraboloid Reflector Antenna – Aperture Blockage, Cassegrain feeding system, Rectangular Microstrip Antenna.

Modern Antennas and Antenna Measurements

Modern antennas - Reconfigurable antenna, Active antenna, Dielectric antenna for terrestrial mobile communication systems, Embedded antennas, UWB antenna, Plasma antenna. Antenna Measurements: Test Ranges, Measurement of Gain, Radiation pattern, VSWR, Impedance, Efficiency, Polarization.

Propagation of radio waves

Ground wave propagation, Space wave propagation, Ionosphere - critical frequency, Maximum Usable Frequency, Skip distance, Virtual height, Radio noise of terrestrial and extra-terrestrial origin, Tropospheric wave propagation, Principle of Wave Propagation between Buried Antennas.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basic mechanism of radiation and antenna parameters.

CO2: Analyze various types of antennas and their parameters.

CO3: Analyze propagation of radio waves in different mediums.

CO4: Determine antenna parameters for different types of antennas and arrays.

CO5: Design antenna and array for the specified condition.

COs, POs, and PSOs - Articulation matrix

Course Outcom	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO5	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC020	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. John D Kraus, Ronalatory Marhefka and Ahmad S Khan, “Antennas and Wave Propagation”, 5th Edition Tata McGraw Hill Book Company, 2017.
2. Jordan E.C and Balmain, “Electro Magnetic Waves and Radiating Systems”, 2nd Edition, Prentice Hall of India, 2015.
3. Constantine.A.Balanis, “Antenna Theory Analysis and Design”, Wiley student Edition, 2015.
4. Ganesh Rao D, Somanathannair B, Deepa Reghunath, “Antennas and Radio Wave Propagation”, Sanguine Technical Publishers, Bangalore, 2007.

5. Amit S. Kesar and Eyal Weiss, “Wave Propagation between Buried Antennas”, IEEE Transactions on Antennas and Propagation, Vol. 61, No. 12, December 2013.

20EC021	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

This course will enable the students to design combinational and sequential logic circuits using HDL. It also imparts practical knowledge on the different types of low power adders and multipliers.

COURSE CONTENT:

Simulation using HDL:

1. Design and simulation of Full Adder and Full Subtractor.
2. Design and simulation of Multiplexer and Demultiplexer.
3. Design and simulation of Encoder and Decoder.
4. Design and simulation of 4-Bit Comparator.
5. Design and simulation of 4-Bit Multiplier.
6. Design and simulation of Latch and Flip Flops.
7. Design and simulation of Ripple Counter and BCD Counter.
8. Design and simulation of Shift Registers.
9. FPGA Implementation of Traffic light controller.

Experiments using SPICE Simulation:

10. DC and Transient Analysis of CMOS Inverter Logic Gates and D-Latch.
11. DC and Transient Analysis of CMOS NAND and NOR Logic Gates.
12. Design of Differential Amplifier.
13. Design of Flip-flops.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Analyze the performance of CMOS NAND, NOR Logic Gates and D-Latch using SPICE tool.

CO2: Design and simulate Combinational and Sequential Logic circuits using HD**L**

CO3: Design and implement digital Circuit using FPGA

CO4: Design and simulate Combinational and Sequential logic circuits using SPICE tool.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO2	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO3	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO4	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC021	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Weste and Harris: CMOS VLSI Design: A Circuits and Systems Perspective Pearson Education India, 4th Edition 2015.
2. Samir Palnitkar, “Verilog HDL-A guide to Digital Design and Synthesis” 2nd Edition, Pearson Education in South Asia 2015.
3. J. Bhaskar, A Verilog Primer, Prentice Hall, 2015.
4. M. Morris R. Mano Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog”, Pearson Education, Inc., 2018.
5. J. Bhaskar, A VHDL, Prentice Hall, 2015.

20EC022	DIGITAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVE:

The course will enable the students to learn the practical aspects of waveform coding techniques, digital modulation schemes and Error control coding techniques through conduct of experiments and simulations.

COURSE CONTENT:

LIST OF EXPERIMENTS:

1. Verification of different types of signal sampling and its reconstruction.
2. Implementation of PCM and TDM.
3. Implementation of DM and ADM.
4. Generation of different line coding signalling formats.
5. Verification of digital modulation schemes: ASK, FSK, PSK.
6. Generation of signal constellation plot of BPSK using MATLAB.
7. Verification of PLL Characteristics and its use as Frequency Multiplier
8. Simulation of signal constellation of QPSK using MATLAB.
9. Simulation of Probability of bit error for BFSK and QPSK modulation schemes using MATLAB.
10. Simulation of linear block code with error control coding capability using MATLAB.
11. Simulation of Convolutional coding scheme using MATLAB.
12. Simulation of Direct Sequence Spread Spectrum using MATLAB Simulink.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Demonstrate the operation of base band and band pass signaling schemes through conduct of experiments.

CO2: Develop and interpret the waveforms of different line coding signaling formats.

CO3: Analyze the performance of band-pass keying techniques through simulations**.**

CO4: Analyze the performance of channel coding techniques through simulations.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3
CO3	-	2	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	-	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC022	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	2	-	3	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. Dennis Silage, “Digital Communication Systems using MATLAB and Simulink”, 2nd edition, Bookstand Publishers, 2009.
2. Prof Shaik Aqeel, “Scilab Manual for Analog and Digital Communication Laboratory”.
3. S. Haykin, “Digital Communication Systems”, John Wiley, 2018.
4. B. Sklar, “Digital Communication Fundamentals and Applications”, 2nd Edition, Education, 2013.
5. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2013.

20EC901	DESIGN PROJECT	L	T	P	C
		0	0	6	3

COURSE OBJECTIVE:

This course will enable the students to solve a specific problem right from its identification and literature review till the successful solution of the same. This also trains the students in preparing project reports and to face reviews and viva voce examination.

COURSE CONTENT:

The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the Project Coordinator. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Take up any challenging practical problems and find solution by formulating proper methodology.

CO2: Formulate a real-world problem, identify the requirement and develop the design solutions.

CO3: Identify technical ideas, strategies and methodologies.

CO4: Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

COs, POs, and PSOs - Articulation matrix

Course Outcomes	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	3	-	3	-	-	2	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO2	-	2	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC901	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

20AC002	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVE

To enable the students to understand the Historical Background of Indian constitution as well as to interpret the Fundamental Duties and its legal status. It further enables them to understand the Scope of the Right to Life and Personal Liberty.

COURSE CONTENT

Historical perspective of the Constitution of India

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution of India - Salient features and characteristics of the Constitution of India.

Fundamental rights and legal status

Scheme of the fundamental rights - The scheme of the Fundamental Duties and its legal status -

The Directive Principles of State Policy – Its importance and implementation.

The constitution powers

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India – The constitution powers and status of the President of India - Amendment of the Constitutional Powers and Procedure.

Constitutional amendments

The historical perspectives of the constitutional amendments in India - Emergency Provisions: National Emergency, President Rule, Financial Emergency - Local Self Government – Constitutional Scheme in India.

Right to Life and Personal Liberty

Scheme of the Fundamental Right to Equality - Scheme of the Fundamental Right to certain Freedom under Article 19 - Scope of the Right to Life and Personal Liberty under Article 21.

COURSE OUTCOMES:

At the end of the course, the student will have the

CO1: Understand and abide by the rules of the Indian constitution.

CO2: Comprehend the constitutional rights & fundamental rights.

CO3: Understand the form of Government in India.

CO4: Comprehend the Parliamentary System and the Constitutional Scheme in India.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-

Program Articulation matrix

20AC002	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-

REFERENCES:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, First Edition, 2015.
3. Granville Austin, Working Democratic Constitution: The Indian Experience, Oxford Publication. 2003.
4. Jain M P, Indian Constitution Law, Seventh Edition, Lexis Nexis, 2014.
5. The Constitution of India (Bare Act), Government Publication, 1950.

SEVENTH SEMESTER SYLLABUS

20EC023	OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to gain knowledge on the concepts of optical fiber modes and losses, optical fiber sources, receivers, transmission techniques and optical networks.

COURSE CONTENT:

Introduction to optical fibers

Need for optical communication – Advantages and applications – EM spectrum– system model description – selection of system components –Overview of Modes – Key Modal concepts – Linearly Polarized Modes – Single Mode Fibers – Graded Index fiber structure.

Signal Degradation in optical fibers

Attenuation, Scattering Losses, Absorption Losses, Leaky modes, mode coupling losses, Bending Losses, Combined Losses in the fiber – Polarization mode dispersion – Intermodal dispersion, Material dispersion, Wave guide dispersion, Total dispersion.

Fiber optical Sources

Characteristics and requirements – Source Laser Diodes and LED's characteristics, Comparison and applications. Splices and connectors – Power Launching and Coupling: Source to fiber power launching – Lensing Schemes for coupling improvement.

Fiber optical receivers

Physical principles of Photodiodes, PIN Photo detector – Avalanche Photodiodes-Photo detector Noise, Comparisons of photo detectors– Fundamental Receiver operation – Receiver configurations – Pre-amplifier for detectors.

Optical networks and System transmission

Basic Networks – SONET/SDH – Broadcast and select WDM Networks – Wavelength Routed Networks – Operational Principles of WDM Performance of WDM + EDFA system – Soliton.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basic concepts of optical communication system.

CO2: Analyze signal degradation mechanisms in order to achieve efficient optical communication.

CO3: Understand the operation of LED and LASER diodes and to analyze their characteristics.

CO4: Understand the operations of PIN and APD and to analyze their characteristics.

CO5: Evaluate the fiber parameters of an optical communication.

CO6: Analyze optical networks and evaluate the performance of fiber optic communication system.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	3	-
CO6	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC023	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. G.Keiser, “Optical fiber communication”, 5th Edition, McGraw-Hill, New York, 2017.
2. G.P. Agarwal, “Fiber optic communication systems”, 4th Edition, John Wiley & Sons, New York, 2017.
3. John Senior, “Optical Fiber Communications: Principles and Practices”, 3rd Edition Prentice Hall Publications, New Delhi, 2014.
4. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
5. Ramaswami, Sivarajan and Sasaki, “Optical Networks-A Practical Perspective”, 3rd edition, Morgan Kaufmann, 2009.

20EC024	RF AND MICROWAVE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the basic principles, characteristics, and applications of commonly used microwave devices, techniques for designing the microwave circuits and various measurement procedures of different microwave parameters.

COURSE CONTENT:

Two Port Network Theory

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters – Different types of interconnection of Two port networks – High Frequency parameters – Properties of S-parameters – Reciprocal and lossless Network – RF behaviour of Resistors, Capacitors and Inductors.

RF Amplifiers and Matching Networks

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Impedance matching using discrete components – Two component matching networks – Frequency response and quality factor – T and Pi Matching Networks – Microstrip Line Matching Networks.

Passive and Active Microwave Devices

Terminations – Attenuators – Phase shifters – Directional couplers – Hybrid Junctions – Power dividers – Circulator –Isolator – Gunn diode oscillator – IMPATT, TRAPATT, BARITT diode oscillator and amplifier – Varactor diode Manley–Rowe relations.

Microwave Generation

Introduction to M and O Type tubes, Two cavity Klystron Amplifier: Velocity and Current modulation – Reflex Klystron oscillator – Traveling wave tube amplifier – Cylindrical Magnetron oscillator – Backward wave Crossed field amplifier and oscillator.

Microwave Measurements

Measuring Instruments: Principle of operation and application of VSWR meter, Power meter, Spectrum Analyzer, Network Analyzer – Measurement of Impedance, Frequency, Power – Calorimeter method, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters – Microwave Hazards.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the principles of operations of active and passive microwave devices.

CO2: Estimate the scattering parameters for passive networks.

CO3: Measure the performance parameters of Microwave devices.

CO4: Analyze RF oscillators and design RF amplifiers based on stability and gain considerations.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	3	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	3	-
CO4	-	1	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	2	3

Program Articulation matrix

20EC024	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	3

REFERENCES:

1. David M. Pozar, "Microwave Engineering: Theory and Techniques", 4th Edition, Wiley India (P) Ltd., New Delhi,2020.
2. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design: Theory and Applications", 2nd Edition Pearson Education Inc., 2011.
3. Robert E Colin, "Foundations for Microwave Engineering", 4th Edition, John Wiley & Sons Inc.,2013.
4. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Prentice-Hall, 2013.
5. Annapurna Das and Sisir K Das, "Microwave Engineering", 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2020.

20EC025	OPTICAL AND MICROWAVE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

This course will enable the students to understand the working principle of optical sources, detector, fibers and microwave components. The behavior of the optical and microwave devices will be demonstrated.

COURSE CONTENT:

List of Experiments

1. Digital Communication through optical link
2. Measurement of Numerical Aperture of optical fiber.
3. Measurement of Attenuation, coupling and Bending Losses.
4. Measurement of Eye Pattern
5. Characteristics of light sources.
6. Characteristics of light detectors
7. Mode Characteristics of Reflex Klystron Oscillator
8. Characteristics of Gunn Diode Oscillator
9. Measurement of S- Parameters of Isolator and Circulator
10. Measurement of S- Parameters of E –plane Tee, H-plane Tee and Magic Tee
11. Measurement of Radiation Pattern of Horn Antenna
12. Characteristics of Directional Coupler
13. Measurement of VSWR of microwave passive devices
14. Measurement of Frequency using slotted line method.
15. Simulation of Microstrip Antenna
16. Simulation of Optical Fiber Communication System

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the working principle of optical sources, detector and optical fiber.

CO2: Understand the characteristics of microwave sources.

CO3: Demonstrate microwave measurement procedures and analysis the behavior of microwave components.

CO4: Establish optical communication link and measure the losses in the optical fiber.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-
CO4	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

Program Articulation matrix

20EC025	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	2	-	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	3	-

REFERENCES:

1. David M. Pozar, “Microwave Engineering”, 4th Edition Wiley India (P) Ltd., New Delhi,2020.
2. Annapurna Das and Sisir K Das, “Microwave Engineering”, 4th Edition, Tata McGraw Hill, 2020.
3. Gerd Keiser, “Optical Fiber Communications”, 5th Edition, Tata McGraw Hill, 2017.
4. Microwave Experimental Manual, The Scientific Instrument CO. LTD., Ghaziabad.
5. Optical Fiber and Digital Communication Trainer User Manual, Benchmark Electronic Systems (P) Ltd., Chennai.

20EC902	FINAL YEAR PROJECT - I	L	T	P	C
		0	0	6	3

COURSE OBJECTIVE:

This course will enable the students to solve a specific problem right from its identification and literature review till the successful solution of the same. The course also trains the students in preparing project reports and to face reviews and viva voce examination.

COURSE CONTENT:

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Identify a real-world problem and its requirements ethically.

CO2: Propose technical ideas, strategies and methodologies for the chosen problem.

CO3: Design engineering solutions to complex problems in a systematic manner.

CO4: Utilize the new tools, algorithms, techniques for obtaining the solution.

CO5: Communicate with engineers and the community at large in written and oral form.

CO6: Report and present the findings of the work conducted by comparing several existing solutions for the problems identified.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	3	-	-	-	-	3	-	-	-	-	3	-	3	-	3	-	3	-	3	-	-	3	-	-	3	3	-
CO2	-	2	-	-	-	-	-	-	3	-	-	-	-	2	-	2	-	3	-	3	-	3	-	-	3	-	-	3	-	-
CO3	-	1	-	2	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	3	-	-	3	-	3
CO4	-	3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-	-	3	-	-	-	-	3	-	-	3	3	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	3	-	3	3	-	-	3	-	3	3	-	-	-	3	-	3	-	-
CO6	-	2	-	3	-	-	-	3	-	-	-	-	3	-	3	-	-	-	3	3	-	3	3	3	3	-	-	3	3	-

Program Articulation matrix

20EC902	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	3	3	3	3	-	3	3	3	3	-	3	3	3	3	3	3	3	3	3	-	3	3	3

EIGHTH SEMESTER SYLLABUS

20EC903	FINAL YEAR PROJECT - II	L	T	P	C
		0	0	16	8

COURSE OBJECTIVE:

This course will enable the students to solve a specific problem right from its identification and literature review till the successful solution of the same. This course also train the students in preparing project reports and to face reviews and viva voce examination.

COURSE CONTENT:

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Identify a real-world problem and its requirements ethically.

CO2: Propose technical ideas, strategies and methodologies for the chosen problem.

CO3: Design engineering solutions to complex problems in a systematic manner.

CO4: Utilize the new tools, algorithms, techniques for obtaining the solution.

CO5: Communicate with engineers and the community at large in written and oral form.

CO6: Report and present the findings of the work conducted by comparing several existing solutions for the problems identified.

COs, POs, and PSOs - Articulation matrix

Course Outcome	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO1	-	2	-	3	-	-	-	-	3	-	-	-	-	3	-	3	-	3	-	3	-	3	-	-	3	-	-	3	3	-
CO2	-	2	-	-	-	-	-	-	3	-	-	-	-	2	-	2	-	3	-	3	-	3	-	-	3	-	-	3	-	-
CO3	-	1	-	2	-	3	-	3	-	-	3	-	-	-	-	-	-	1	-	1	-	1	-	-	3	-	-	3	-	3
CO4	-	3	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	-	-	3	-	-	-	-	3	-	-	3	3	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	3	-	3	3	-	-	3	-	3	3	-	-	-	3	-	3	-	-
CO6	-	2	-	3	-	-	-	3	-	-	-	-	3	-	3	-	-	-	3	3	-	3	3	3	3	-	-	3	3	-

Program Articulation matrix

20EC903	PO1		PO2		PO3			PO4			PO5			PO6		PO7		PO8		PO9		PO10			PO11		PO12		PSO 1	PSO 2
	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC1	PC2	PC3	PC1	PC2	PC1	PC2		
CO	-	3	-	3	-	3	-	3	3	3	3	-	3	3	3	3	-	3	3	3	3	3	3	3	3	3	-	3	3	3

PROFESSIONAL ELECTIVES

ELECTIVE – I & II GROUP

20ECP01	ELECTRONIC MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the functional elements of Electronics Instruments, fundamentals of electrical instruments, various measurement techniques, storage and display devices, transducers and data acquisition system.

COURSE CONTENT:

Electronics Instruments

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement - Standards and calibration – Principle and types of analog and digital voltmeters, ammeters, multimeters - Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss.

Measuring Instruments

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

Storage and display Devices

Magnetic disk and tape –X-R recorder - digital plotters and printers, CRT display, digital CRO,OLED,LED display systems, LCD, Dot Matrix Display – USB Data Loggers.

Transducers and Data Acquisition Systems

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the characteristics and operation of Electrical and Electronic Instruments.

CO2: Analyze the functions of storage devices, display devices and measuring instruments.

CO3: Select appropriate sensors and measuring instruments for various applications.

CO4: Analyze the functioning of electronic instruments and transducers.

REFERENCES:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2010.
2. J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, Delhi, 2013.
3. J Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2011.
4. H.S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill, II Edition 2010.
5. D.V.S. Moorthy, "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd, 2010.

20ECP02	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the concept of advanced Boolean algebra, hazard free circuits, fault diagnosis, testing methods and architectures of FPGA.

COURSE CONTENT:

Advanced Topics in Boolean Algebra

Shannon's expansion theorem – Consensus theorem – Octal Designation – Run measure – INHIBIT / INCLUSION / AOI / Driver / Buffer Gates – Gate Expander – Reed Muller Expansion, – Synthesis of multiple output combinational logic circuits by product map method – Design of static hazard free and dynamic hazard free logic circuits.

Sequential Circuit Design

Design of synchronous sequential circuit's – design of iterative circuits – ASM chart – ASM Realization – Design of Arithmetic circuits for Fast adder – Array Multiplier – design of asynchronous sequential circuit – Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller.

Fault Diagnosis and Testability Algorithms

Fault diagnosis: Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Design for testability: Test Generation – Masking Cycle – DFT Schemes – Circuit testing fault model – specific and random faults – testing of sequential circuits – Built in Self -Test – Built in Logic Block observer (BILBO) – signature analysis, Reliability driven optimisation and synthesis techniques for combinational circuits.

Digital System Design

Data path, control path -The ASM chart, Arithmetic and logic unit, Shifter, Multiplier – Memory unit Building a Data path, ALU control, pipelined data path and design of main control unit.

Design with FPGA

Digital IC design flow - The role of FPGAs in digital design – FPGA architectures – Configurable logic blocks – configurable I/O blocks – Programmable interconnect – clock circuitry – Emerging FPGA architecture for industrial applications – Case studies(Intel architectures) — Programming Technologies: Antifuse, SRAM, EPROM,EEPROM, Flash Memory.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the Boolean algebra and various types of hazards.

CO2: Apply the testing procedures for combinational circuits to diagnose faults.

CO3: Design synchronous and asynchronous sequential circuits for various applications.

CO4: Design digital systems such as arithmetic and logic unit, data path unit and control unit.

REFERENCES:

1. Charles H.Roth Jr “Fundamentals of Logic Design” Thomson Learning 2014.
2. William I. Fletcher, “An Engineering Approach to Digital Design”, Pearson education, 2015.
3. Parag K.Lala “Fault Tolerant and Fault Testable Hardware Design”, B S Publications, 2012.
4. Satish Grandhi, David McCarthy, Christian Spagnol, Emanuel Popovici and Sorin Cotofana, “Reliability driven optimisation and synthesis techniques for combinational circuits”, 33rd IEEE International Conference on Computer Design (ICCD), 2015.
5. Wayne Wolf, “FPGA-Based System Design”, Prentice Hall, New Delhi, 2012.

20ECP03	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to gain knowledge on operation of digital computer, hardware-software interface, concept of pipelining, and also to evaluate the performance of hierarchical memory system including cache memories and virtual memory.

COURSE CONTENT:

Overview & Instructions

Eight Ideas – Components of a Computer System – Technology – Performance – Power Wall –Uniprocessors to Multiprocessors; Instructions – Operations and Operands Representing Instructions – Logical Operations – Control Operations – Addressing and Addressing Modes.

Arithmetic Operations

ALU - Addition and Subtraction – Multiplication – Division – Floating Point Operations – Subword Parallelism.

Processor and Control Unit

Basic MIPS Implementation – Building Data Path – Control Implementation Scheme – Pipelining – Pipelined Data Path and Control – Handling Data Hazards & Control Hazards – Exceptions.

Parallelism

Instruction-Level - Parallelism – Parallel Processing Challenges – Flynn's Classification – Hardware Multithreading – Multicore Processors.

Memory and I/O Systems

Memory Hierarchy - Memory Technologies – Cache Basics – Measuring and Improving Cache Performance – MMU -Virtual Memory, TLBs – Input /Output System, Programmed I/O, DMA and Interrupts, I/O Processors.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand arithmetic and logic units, I/O devices and hardware-software interfaces.

CO2: Design control units using pipelining technique.

CO3: Evaluate the performance of memory systems.

CO4: Explain parallel processing architectures.

REFERENCES:

1. 1. David A. Patterson and John L. Hennessey, "Computer Organization and Design", 5th Edition, Morgan Kauffman / Elsevier, 2014.
2. 2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 6th Edition, McGraw-Hill Inc., 2012.
3. 3. William Stallings "Computer Organization and Architecture", 7th Edition, Pearson Education, 2006.
4. 4. Vincent P. Heuring and Harry F. Jordan, "Computer System Architecture", 2nd Edition, Pearson Education, 2005.
5. 5. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", 1st Edition, Tata McGraw Hill, New Delhi, 2005.

20ECP04	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the architectures of advanced processors, controllers, their instruction set and interfacing mechanisms.

COURSE CONTENT:

80386 Microprocessor

Introduction to Advanced Processor, Architecture and signal description of 80386 - Register Organization of 80386 - Addressing Modes - Protected mode of operation –Paging - Virtual 8086 Mode.

Pentium Microprocessor

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- – Exception and Interrupts – Instruction set – addressing modes.

ARM Processor

Arcon RISC Machine – Architectural Inheritance – Core & Architectures (ARM7 and ARM 9)- Registers – Pipeline - Interrupts – ARM organization - ARM processor family –ARM instruction set- Thumb Instruction set - The ARM Programmer's model – ARM Development tools.

PIC Microcontroller

CPU Architecture – Instruction set – Interrupts- Timers- I2C Interfacing –UART- A/D Converter –Pulse Width Modulation.

ARDUINO IDE

Introduction to Arduino - Pin configuration and architecture - Device and platform features - Concept of digital and analog ports - Familiarizing with Arduino Interfacing Board - Introduction to Embedded C and Arduino platform - Arduino data types.

Raspberry Pi

Overview of IoT - Introduction to Raspberry Pi - Booting Up RPi- Operating System and Linux Commands - Working with RPi using Python and Sensing Data using Python - IoT Design using Raspberry Pi

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the architecture and functionalities of advanced Microprocessor and Microcontrollers.

CO2: Analyze the instruction set and addressing modes of advanced Microprocessors and Microcontrollers.

CO3: Analyze the programming aspects associated with Pentium and ARM processor.

CO4: Explain the functional usage of advanced microcontroller systems along with interfacing devices for various applications.

REFERENCES:

1. James L. Antonakos, “The Pentium Microprocessor”, Pearson Education, 2011.
2. Steve Furber, “ARM System – On –Chip architecture”, Addision Wesley, 2011
3. John. B. Peatman, “Design with PIC Microcontroller”, Prentice Hall, 2011.
4. Barry. B. Brey, “The Intel Microprocessors Architecture, Programming and Interfacing”,PHI,2012.
5. Gene .H.Miller, “Micro Computer Engineering”, Pearson Education, 2013.

20ECP05	OPTOELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of semiconductor theory, different types of optical emission, detection, the principle concepts of operation of photovoltaics, display devices and opto-electronic modulators.

COURSE CONTENT:

Semiconductor Theory

Basic quantum mechanics, semiconductor statistics, carrier transport, optical processes, and junction theory, Properties of simple and compound semiconductors, Optical absorption, Optical recombination, Recombination and carrier lifetime.

Polarization and Modulation of Light

Polarization. Light Propagation in an Anisotropic Medium: Birefringence. Electro-Optic Effects. Acousto-Optic Modulator. Magneto-Optic Effects. Integrated Optical Modulators Electro-absorption modulators. Non-Linear Optics and Second Harmonic Generation.

Stimulated Emission Devices

Stimulated Emission and Photon Amplification. Stimulated Emission Rate and Einstein Coefficients. Optical Fiber Amplifiers. LASER Oscillation Conditions. Principle of the Laser Diode. Heterostructure Laser Diodes. Rate Equation- Characteristics. Light Emitters for Optical Fiber Communications. Quantum Well and Quantum dot Devices. Vertical Cavity Surface Emitting Lasers (VCSELs). Optical Laser Amplifiers.

Photovoltaics

Photovoltaic Device Principles. PN Junction Photovoltaic I-V Characteristics. Solar Cells Materials, Devices and Efficiencies.

Display Devices

Energy Bands - Direct and Indirect Bandgap Semiconductors: E-k Diagrams. PN Junction Principles. The PN Junction Band Diagram. Light Emitting Diodes. LED Materials. Heterojunction High Intensity LEDs. LED Characteristics. LEDs for Optical Fiber Communications, White LED for display and lighting applications - Liquid crystal displays,

Reflective and Trans reflective types, TFT displays, Plasma displays, LED TV – OLED, AMOLED.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of solid-state physics and characteristics of light.

CO2: Classify various kinds of semiconductor materials in Optoelectronics.

CO3: Understand the mechanisms of light absorption and emission in p-n junctions.

CO4: Analyze different light modulation techniques and optical switching methods.

REFERENCES:

1. S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices", Pearson, 2013.
2. Michael Parker, "Physics of optoelectronics", CRC press, 2018.
3. P. N. Prasad, "Nanophotonics", John Wiley & Sons, 2004.
4. Deng-Ke Yang , Shin Tson Wu, "Fundamentals of Liquid Crystal Devices", Revised edition, John Wiley and Sons, 2015
5. Saleh and Teich, "Fundamentals of Photonics", Wiley Interscience, 2nd Edition, 2013.

20ECP06	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course will enable the students to learn the origin of bioelectric potential and their measurements using appropriate electrodes and transducers. This also familiarize the students with the measurement techniques of biochemical, nonelectrical parameters of human system and various assist devices used in hospitals.

COURSE CONTENT:

Electro-Physiology and Bio-Potential Recording

The origin of Bio-potentials, Bio-potential electrodes, Biological amplifiers, ECG, EEG, EMG, PCG, Lead systems and Recording methods, Typical waveforms and Signal characteristics.

Bio-Chemical and Non Electrical Parameter Measurement

pH, pO2, pCO2, Colorimeter, Auto analyzer, Blood flow meter, Cardiac output, Respiratory measurement, Blood pressure, Temperature, Pulse, Blood cell counters.

Assist Devices

Cardiac pacemakers, DC Defibrillator, Dialyzer, Heart lung machine.

Physical Medicine and Biotelemetry

Diathermies- Shortwave, Ultrasonic and Microwave type and their applications, Surgical Diathermy, Telemetry principles, Frequency selection, Biotelemetry.

Recent Trends in Medical Instrumentation

Thermograph, Endoscopy unit, Laser in medicine, Cryogenic application, Electrical safety, Introduction to Telemedicine.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the bioelectric potentials, electrodes and their characteristics.

CO2: Explain non-electrical parameter measurement techniques.

CO3: Explain the recent developments in the field of biomedical engineering.

CO4: Choose different display devices and recorders for medical application.

REFERENCES:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2012.
2. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2013.
3. John G. Webster, “Medical Instrumentation Application and Design”, 4th Edition, Wiley India Edition, 2011.
4. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2013.
5. L. Nokes, D. Jennings, T. Flint, B. Turton, “Introduction to Medical Electronics Applications”, Little, Brown and Company, USA, 2015.

20ECP07	NUMERICAL ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to solve algebraic and transcendental equations, understand numerical techniques of interpolation in various intervals, differentiation and integration and methods of solving ordinary and partial differential equations.

COURSE CONTENT:

Solution of algebraic and transcendental equations

Solution of algebraic and transcendental equations – Newton – Raphson Method – Method of false position – Solutions of Linear system by Gauss Jordan method, Iterative method – Gauss Seidel Method

Interpolation and Approximation

Interpolation – Lagrangian Polynomials – Newton‘s divided difference formula –Newton Forward and Backward difference formula.

Numerical Differentiation and Integration

Newton’s forward and backward difference formula for derivatives – Trapezoidal and Simpson’s 1/3 rule – Double integrals using Trapezoidal and Simpson’s rules.

Initial and Boundary value problem

Initial value problem: Taylor’s series method – Euler method – Fourth order Runge – Kutta method for solving first order equation, Milne’s and Adam’s predictor and corrector methods. Boundary value problems: Finite difference solution for one dimensional heat equation by explicit and implicit methods – one dimensional wave equation- Two dimensional Laplace equation – Applications of initial and boundary value problems to electronics engineering problems.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basic concepts and techniques for solving algebraic and transcendental equations, numerical techniques of interpolation and error approximations in various intervals in real life situations.

CO2: Understand the knowledge of various techniques for solving first and second order ordinary differential equations.

CO3: Apply the numerical techniques of differentiation and integration for engineering problems.

CO4: Solve the partial and ordinary differential equations with initial and boundary conditions for engineering applications.

REFERENCES:

1. Joe D. Hoffman, "Numerical methods for Engineers and scientists", Wiley, 2015.
2. Gerald C.F. and Wheatley, P.O. "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 7th Edition, 2011.
3. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill New Delhi, 4th edition 2010.
4. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S. Chand Co., Ltd., New Delhi, 2007.
5. T. Veerarajan, "Numerical Methods", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2016.

20ECP08	NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the nascent field of nanoscience, nanotechnology and basics of nanomaterial synthesis and characterization with applications of nanotechnology.

COURSE CONTENT:

Introduction to Nano Technology

Microelectronics towards biomolecule electronics - Particles and waves - Wave-particle duality – Wave mechanics - Schrödinger wave equation - Wave mechanics of particles: Atoms and atomic orbitals - Materials for nano electronics- Semiconductors- Crystal lattices: Bonding in crystals- Electron energy bands- Semiconductor heterostructures- Lattice-matched and pseudomorphic heterostructures - Carbon nanomaterials: nanotubes and fullerenes.

Fundamentals of Nano electronic

Fundamentals of logic devices:- Requirements - dynamic properties - threshold gates; physical limits to computations; concepts of logic devices:- classifications - two terminal devices - field effect devices -coulomb blockade devices - spintronics - quantum cellular automata - quantum computing - DNA computer; performance of information processing systems:basic binary operations, measure of performance processing capability of biological neurons - performance estimation for the human brain.

Nano electronics and Scaling

Introduction to Nanoelectronics – Classical and quantum systems – Current CMOS device technology- International Technology Roadmap for Semiconductor projections – Scaling principles – General scaling ,Characteristic scale length – Limits to scaling – Quantum mechanics, Atomistic effects, Thermodynamic Effects, Practical considerations – Power constrained scaling limits.

Fabrication and Measurement Techniques

Growth, fabrication, and measurement techniques for nanostructures- Bulk crystal and heterostructure growth- Nanolithography, etching, and other means for fabrication of nanostructures and nano devices-Techniques for characterization of nanostructures-Spontaneous formation and ordering of nanostructures- Clusters and nanocrystals- Methods of nanotube growth- Chemical and biological methods for nanoscale fabrication- Fabrication of nano-electromechanical systems.

Logic Devices and Applications

Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport Devices Based on Resonant Tunneling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-Quantum Computing Using Superconductors-Carbon Nanotubes for Data Processing-Molecular Electronics

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the basics of nanotechnology and different fabrication methods.

CO2: understand the behavior of nanomaterial and its related structures.

CO3: apply the fundamentals of nano electronics for engineering applications.

CO4: explain the nanostructure devices and logic circuits.

REFERENCES:

1. George W. Hanson, “Fundamentals of Nano electronics”, Pearson 2009.
2. Korkin, Anatoli; Rosei, Federico (Eds.), “Nano electronics and Photonics”, Springer 2008.
3. Mircea Dragoman, Daniela Dragoman, “Nano electronics: principles and devices”, CRC Press 2006

4. Mircea Dragoman and Daniela Dragoman, “Nanoelectronics Principles and Devices”, Artech house, Boston, 2006.
5. W.R.Fahrner, “Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques”, Springer (India), New Delhi, 2011.
6. Rainer Waser, “Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices”, Wiley – VCH,Germany, 2005.

20ECP09	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the EMI/EMC concepts, various coupling principles, measurement techniques and the different compatibility techniques to reduce EMI.

COURSE CONTENT:

EMI Environment

EMI/ EMC concepts and definitions, Intra and Inter system EMI, sources and victims of EMI, conducted and radiated EMI, Transient EMI, ESD, Radiation Hazards, Frequency Spectrum Allocation.

EMI coupling principles

Common mode coupling, Differential mode coupling, Common Impedance coupling, Ground loop coupling, Field to cable coupling, Cable to Cable Coupling, Power Mains and Power Supply coupling.

Standards and Regulation

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

EMI Control techniques

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

Test Methods and Instrumentation

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and

factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts and issues of EMI/EMC.

CO2: Understand the national and international EMI/EMC standards.

CO3: Explain the principles and methods of EMI measurements and related instruments.

CO4: Summarize the characteristics of EMI control techniques.

REFERENCES:

1. Prasad Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 2nd Edition, 2010.
2. Clayton R. Paul, "Introduction to Electromagnetic compatibility", John Wiley & Sons, V 2nd edition, 2012 Reprint.
3. Henry W. Ott, "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, 2009 Reprint.
4. Dr.Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2004.
5. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol. I-V,1988.

20ECP10	TELECOMMUNICATION SWITCHING AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the various multiplexing techniques, digital switching techniques, network synchronization, control and management. This course also focuses on the principles and working of SONET, ISDN and Cellular networks.

COURSE CONTENT:

Multiplexing

Transmission Systems – FDM – TDM – Line Coding – SONET/SDH: SONET Multiplexing Overview – SONET Frame Formats – SONET Operations – Administration and Maintenance – Payload Framing and Frequency Justification – Virtual Tributaries – DS3 Payload Mapping – E4 Payload Mapping – SONET Optical Standards – SONET Networks – SONET Rings: Unidirectional Path-Switched Ring –Bidirectional Line – Switched Ring.

Digital Switching

Switching Functions – Space Division Switching – Time Division Switching – Two – Dimensional Switching: STS Switching – TST Switching – No-4 ESS Toll Switch – Digital Cross – Connect Systems - Digital Switching in an Analog Environment – Elements of SSN07 signaling. Signal Exchanges-State Transition Diagrams – Stored Program Control.

Network Synchronization Control and Management

Timing: Timing Recovery: Phase – Locked Loop – Clock Instability – Jitter Measurements – Systematic Jitter – Timing Inaccuracies: Slips – Asynchronous Multiplexing – Network Synchronization – Network Control – Network Management.

Digital Subscriber Access

ISDN: ISDN Basic Rate Access Architecture – ISDN U Interface – ISDN D Channel Protocol – High – Data – Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line – VDSL – Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems – Integrated Digital Loop Carrier Systems – Next Generation Digital Loop Carrier – Fiber in the Loop – Hybrid Fiber Coax Systems – Voice band Modems: PCM Modems – Local Microwave Distribution Service – Digital Satellite Services.

Networks

Introduction – Analog Networks-Integrated Digital Networks – Integrated Services Digital Networks – Cellular Radio Networks – Intelligent Networks – Private Networks – Charging – Routing General – Automatic Alternative Routing.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the operation and working principles of SONET / SDH, analog & digital networks.

CO2: understand the concepts of ISDN and cellular networks.

CO3: apply the various modulation techniques in telecommunication networks.

CO4: analyze the performance of analog and digital networks, ISDN and cellular networks.

REFERENCES:

1. Viswanathan T., “Telecommunication Switching System and Networks”, Prentice Hall of India Ltd., 2015.
2. Flood J.E., “Telecommunications switching traffic and networks”, Pearson Education Ltd., 2011.
3. John.C. Bellamy, “Digital Telephony”, John Wiley & Sons, 3rd Edition, 2009.
4. Behrouz A. Forouzan, “Data Communications and Networking”, TMH, 5th Edition, 2012.
5. William Stallings, “Data and Computer Communications”, 10th Edition 2014.

PROFESSIONAL ELECTIVES

ELECTIVE – III & IV GROUP

20ECP11	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the image fundamentals and mathematical transforms necessary for image processing. This course imparts knowledge on operations in both the spatial and frequency domains.

COURSE CONTENT:

Digital Image Fundamentals

Introduction – Origin – Steps in Digital Image Processing – Elements of Visual Perception – A Simple image model - Sampling and Quantization – Relationships between pixels – Arithmetic and Logical operations on images – Image Transformations – DFT, DCT and Hadamard transform – Introduction to colour image processing.

Image Enhancement

Spatial and Frequency Domain methods – Point processing, Intensity Transformations, Histogram Processing – Spatial filtering, Smoothing Filters, Sharpening Filters – Enhancement in the Frequency Domain, Low Pass Filtering, High Pass Filtering – Homomorphic filtering.

Image Restoration and Segmentation

A model of Image degradation / Restoration process – Noise models – Mean Filters – Order Statistics filters- Adaptive filters - Band Reject Filters – Band pass Filters – Notch filters – Inverse filtering.
Segmentation: Detection of Discontinuities – Region based Segmentation – Morphological processing – Erosion and Dilation.

Image Compression

Fundamentals of Compression – Image Compression Models – Error free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

Image Representation and Recognition

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor – Regional Descriptors – Topological feature, Texture – Recognition based on matching – Set Registration – Typical computer vision system.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the concepts of image fundamentals and the related image processing operations.

CO2: apply the image fundamentals and image processing operations for multimedia techniques.

CO3: apply the image processing operations to perform feature recognition.

CO4: apply image enhancement, restoration, segmentation and compression techniques.

CO5: analyze the image processing operations using spatial and frequency domain techniques

REFERENCES:

1. Rafael C. Gonzales and Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2010.
2. Anil K Jain. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", 3rd Edition Tata McGraw Hill Pvt. Ltd., 2011.
4. William K Pratt, "Digital Image Processing", John Willey, 2010.
5. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", 1st Edition, PHI Learning Pvt. Ltd., 2011.

20ECP12	PRINCIPLES OF SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the concepts of satellite, working principle of communication satellites in relation with the other terrestrial systems and their applications.

COURSE CONTENT:

Satellite Orbits

Overview of Satellite Communication - Kepler's Laws, Newton's Law - Frequency Bands - Orbital Parameters, LEO, MEO and GEO Orbits – Geo-stationary and Non Geo-stationary Orbits - Orbital Perturbations, Station Keeping – Look Angle Determination- Limits of Visibility – Eclipse - Sub Satellite Point –Sun Transit Outage.

Space Segment & Earth segment

Spacecraft Technology– Structure, Primary Power, Attitude and Orbit Control, Thermal Control and Propulsion, Communication Payload and Supporting Subsystems, Telemetry, Tracking and Command: Introduction to Earth Segment– Receive – Only Home TV Systems – Outdoor Unit – Indoor Unit for Analog (FM) TV – Master Antenna TV System – Community Antenna TV System – Transmit – Receive Earth Stations.

Satellite Access

Modulation and Multiplexing: Voice, Data, Video, Analog – Digital Transmission System, Digital Video Broadcast, Multiple Access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum Communication.

Satellite Link Design

Equivalent Isotropic Radiated Power – Transmission Losses – Free-Space Transmission – Feeder Losses – Antenna Misalignment Losses – Fixed Atmospheric and Ionospheric Losses – Satellite Uplink and Downlink Analysis and Design - Link Power Budget Equation, E/N Calculation–Performance Impairments–System Noise, Inter Modulation and Interference.

Satellite Applications

INTELSAT Series, INSAT, VSAT, INMARSAT, GRAMSAT, GSM, GPS, Direct to home Broadcast (DTH), Digital Audio Broadcast (DAB) – World Space Services, Business TV (BTV) -Specialized Services.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: apply the concepts of satellite orbits, space segment, earth segment, and in real world scenarios.

CO2: analyze the different types of losses for satellite link design.

CO3: analyze the various methods of satellite access FDMA, TDMA, CDMA and spread spectrum communication.

CO4: analyze the satellite link design and to measure its performance parameters.

REFERENCES:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, McGraw Hill International, 2016.
2. Timothy Pratt, Charles Bostian Jermey Allnutt, “Satellite Communications”, John Wiley, 2nd Edition, 2013.
3. Gerard Maral, Michel Bousquet, “Satellite Communications Systems: Systems”, Techniques and Technology, 5th Edition, Wiley, 2014.

4. K.N.Raja Rao, "Satellite Communication: Concepts and Applications", 2nd Edition, Pearson, 2012.
5. Anil K. Maini, VarshaAgrawal, "Satellite Communication", Wiley, 2nd Edition, 2010.

20ECP13	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the Layered Architectures, Broadband and IP Networks .This course also focusses on ATM networks and high Performance networking with WiMax and UWB.

COURSE CONTENT:

Introduction

Networking principles – Digitalization Service and layered architecture – traffic characterization and QoS – network services – Network elements – Network Monitoring – Network Control – network mechanisms – Network Element Management.

Broadband Networks

Introduction – Multihop Wireless Broadband Networks – Mesh Networks – Importance of Routing Protocols – Routing Metrics – Packet Scheduling – Admission Control – Classification of Routing Protocols – MANET Routing Protocols.

IP Networks

Technology Trends in IP Networks – internet protocol – IP Packet Communications in Mobile Communication Networks – TCP and UDP – Performance of TCP/IP networks – Circuits Switched Networks – SONET – DWDM – Fiber to home – DSL – Intelligent Network (IN) Scheme – CATV and layered network.

ATM Networks

ATM Reference Model – The ATM Layer – The ATM Adaptation Layer (AAL) – Traffic Classes –Traffic Management and Quality of Service – Traffic Descriptor – Traffic Shaping – ABR and Traffic Congestion – Network Management – Layer Management – ATM Signaling – ATM Addressing Format – Connection Establishment – IP/ATM Internetworking – IP Multicast over ATM.

High Performance Networking With WiMAX and Ultra Wideband

(WPAN)

Introduction – WiMAX Overview – Competing Technologies – Overview of the Physical Layer – PMP Mode – Mesh Mode – Multihop Relay Mode–Time-Hopping Ultra-wideband – Direct Sequence Ultra-wideband – Multiband – Other Types of UWB – LTE.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the architecture of High performance computer networks.

CO2: Summarize the network protocols for computer networks.

CO3: Apply mathematical models to analyze network related issues.

CO4: Explain the types and architectures of WiMax and UWB.

REFERENCES

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", Harcourt and Morgan Kauffman Publishers, London, 2nd Edition, 2011.
2. Leon Garcia and Widjaja, "Communication networks", Tata McGraw Hill, 2nd Edition, 2014.
3. Lumit Kasera and Pankaj Sethi, "ATM Networks", Tata McGraw Hill, 2010.
4. Keiji Tachikawa, "W-CDMA Mobile Communication System", John Wiley & Sons, 2012.
5. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, Kee Chaing Chua and Jon W. Mark, "Wireless Broadband Networks", John Wiley & Sons, 2009.

20ECP14	REAL TIME CONCEPTS FOR EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the embedded system design, architecture and programming of ARM processor, embedded programming, real time operating systems, hardware accelerators and networks.

COURSE CONTENT:

Introduction to Embedded Computing

Complex systems and microprocessors – Embedded system design process – Formalism for system design: Design methodologies- Design flows – Requirement Analysis – Specifications-System analysis and architecture design -Design example: Model train controller- – Quality Assurance techniques - Designing with computing platforms – consumer electronics architecture – platform-level performance analysis.

Computing Platform and ARM Processors

ARM Processor: Fundamentals- ARM Architecture Versions -Instruction Set and Programming using ARM Processor- CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses- Memory devices – I/O devices – Component interfacing- System Level Performance Analysis Parallelism. Design Example: Data Compressor.

Embedded Programming

Components for embedded programs- Models of programs- Assembly, linking and loading– compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing. Design Example: Software Modem.

Processes and Operating Systems

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive realtime operating systems- Priority based scheduling- Interprocess communication mechanisms– Evaluating operating system performance- power optimization strategies for processes– Example Real time operating systems-POSIX-Windows CE. - Distributed embedded systems– MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit.

Hardware Accelerators & Networks

Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller– Video accelerator.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the embedded computing and role of ARM Processors in embedded systems.

CO2: Apply the concept of process, multi-processes and operating systems in embedded system design.

CO3: Apply the various communication protocols in distributed embedded computing platform.

CO4: Analyze optimization and proper scheduling of the process for real time embedded applications.

REFERENCES:

1. Marilyn Wolf, Computers as Components - Principles of Embedded Computing System Design, Fourth Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Jane W.S.Liu, Real Time Systems, Pearson Education, Third Indian Reprint, 2003.
3. Jonathan W.Valvano, Embedded Microcomputer Systems Real Time Interfacing, Third Edition Cengage Learning, 2012.
4. David. E. Simon, An Embedded Software Primer, International Softcover Edition,Addison, Wesley Professional, 2011.
5. K.V.K.K.Prasad, Embedded Real-Time Systems: Concepts, Design &Programming, Dream Tech Press, 2005.

20ECP15	SOFTWARE FOR EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the embedded programming, C programming tool chain in Linux, basic concepts of embedded C, Embedded OS & Python Programming.

COURSE CONTENT:

Embedded Programming

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

C Programming Tool Chain in Linux

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library.

Embedded C

Adding Structure to ‘C’ Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

Embedded Operating System

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS- Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

Python Programming

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution Environment.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the fundamentals of embedded programming and GNU C programming tool chain in Linux.

CO2: apply GNU C to develop embedded software.

CO3: apply Embedded C to meet real-time constraints.

CO4: analyze the design considerations of embedded operating system for embedded applications.

REFERENCES:

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2016.
2. Michael J Pont, "Embedded C", Pearson Education, 2017.
3. Christian Hill, "Learning Scientific Programming with Python", Cambridge University Press, 2016.
4. Wesley J.Chun, "Core python application Programming 3rd Edition", Pearson Education, 2016.
5. Mark J.Guzdial, "Introduction to computing and programming in python – a Multimedia approach", 4th edition, Pearson Education, 2015.

20ECP16	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the various characteristics of intelligent agents search strategies in AI, AI problems, software agents and the various applications of AI.

COURSE CONTENT:

Introduction

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem Solving Methods

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

Knowledge Representation

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

Software Agents

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

Applications

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: explain the problem using first order and predicate logic.

CO2: choose appropriate search algorithms for any AI problem.

CO3: apply the concepts of Artificial Intelligence in Engineering.

CO4: explain software agents for solving problem.

REFERENCES:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, Third Edition, 2009.
2. I. Bratko, “Prolog Programming for Artificial Intelligence”, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones, “Artificial Intelligence: A Systems Approach(Computer Science)”, Jones and Bartlett Publishers, Inc.; First Edition, 2008

4. Nils J. Nilsson, “The Quest for Artificial Intelligence”, Cambridge University Press, 2009.
5. William F. Clocksin and Christopher S. Mellish, “Programming in Prolog : Using the ISO Standard”, Fifth Edition, Springer, 2003.
6. Gerhard Weiss, “Multi Agent Systems”, Second Edition, MIT Press, 2013.

20ECP17	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the different sources of power dissipation in CMOS & MIS structure, the different types of low power adders and multipliers, low power static RAM architecture & the source of power dissipation in SRAM.

COURSE CONTENT:

Power Dissipation in CMOS

Sources of power Dissipation–Physics of power dissipation in MOSFET devices, Power dissipation in CMOS, Power dissipation in Domino CMOS-Low power VLSI design limits.

Power Estimation

Modeling of signals- Signal probability calculation-probabilistic techniques for signal activity estimation-statistical techniques for power estimation-estimation of glitch power-sensitivity analysis power estimation at the circuit level-estimation of maximum power.

Synthesis for Low power

Behavioral level transforms-Algorithm using First –Order, second, Mth Order Differences-Parallel Implementation Pipelined Implementation- Logic level optimization– Technology dependent and Independent– -Circuit level-Static, Dynamic, PTL, DCVSL, PPL.

Low power static RAM Architectures

Organization of a static RAM, MOS static RAM memory cell, Banked organization of SRAMs, Reducing voltage swings on bit lines, Reducing power in the write diver circuits, Reducing power in sense amplifier circuits.

Low energy computing using energy recovery techniques

Energy dissipation in transistor channel using an RC model, Energy recovery circuit design, Designs with partially reversible logic, Supply clock generation.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the different techniques involved in low power adders and multipliers.

CO2: explain the impact of various low power transforms and various energy recovery techniques.

CO3: analyze different source of power dissipation.

CO4: identify and analyze the different techniques involved in low power SRAM.

REFERENCES:

1. K. Roy and S.C. Prasad, "Low Power CMOS VLSI Circuit Design", Wiley, 2010.
2. K.S. Yeo and K. Roy, "Low-Voltage, Low-Power VLSI Subsystems", Tata McGraw-Hill, 2006.
3. Dimitrios Soudris, Chirstian Pignet and Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2010.
4. James B. Kuo and Shin – Chia Lin, "Low voltage SOI CMOS VLSI Devices and Circuits", John Wiley and Sons, 2001.
5. J.B Kuo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley, 1999.
6. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer, 1997.

20ECP18	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the architectures, protocol stack, routing, switching, the resource allocation methods, network management and protection methods.

COURSE CONTENT:

Optical System Components

Light Propagation in optical fibers – Loss & bandwidth, System limitations, Non Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

Optical Network Architectures

Introduction to Optical Networks; SONET / SDH, Metropoliton - Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-

Access Control Protocols, Test beds for Broadcast & Select WDM; Wavelength Routing Architecture.

Wavelength Routing Networks

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

Packet Switching and Access Networks

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

Network Design and Management

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the backbone infrastructure for present and future communication

CO2: understand the network management, its protection methods, network architectures and its protocol stack.

CO3: analyze the differences in the design of data plane, control plane, routing, switching and resource allocation methods.

CO4: explain the advances and recent trends in the networking and switching approaches.

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pvt. Ltd., 3rd Edition, 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, 1st Edition, 2002.
3. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
4. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.

20ECP19	ELECTRONIC PACKAGING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the various techniques of electronic system packaging, electrical issues in packaging, PCB assembly, surface mount technology, reliability and testing of electronic packaging.

COURSE CONTENT:

Overview of Electronic Systems Packaging

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

Electrical Issues in Packaging

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitics.

Chip Packages

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in - package (SIP); Passives: discrete, integrated, and embedded.

PCB, Surface Mount Technology and Thermal Considerations

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements

Testing

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures – thermo mechanically induced –electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the various electronic packaging types and fundamentals of electrical packaging issues.

CO2: understand the concepts of thermal management and reliability of electronic packages

CO3: explain the single chip and multichip packaging techniques.

CO4: analyse the concepts of testing and testing methods of electronic packaging.

REFERENCES:

1. Tummala, Rao R., "Fundamentals of Microsystems Packaging", McGraw Hill, 2001.
2. Glenn R. Blackwell, "The electronic packaging handbook", CRC Press, 2017.
3. Tummala, Rao R, "Microelectronics packaging handbook", McGraw Hill, 2008.
4. Bosshart, "Printed Circuit Boards Design and Technology", TataMcGraw Hill, 1983.
5. R.G. Kaduskar and V.B.Baru, "Electronic Product design", Wiley India, 2011.

20ECP20	INTRODUCTION TO MEMS SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to acquire the basic knowledge of characteristics of semiconductors, solid mechanics to fabricate MEMS devices, and to understand micro fabrication and Micromachining techniques, sensors, actuators and various types of polymer and optical MEMS.

COURSE CONTENT:

Introduction

Intrinsic Characteristics of MEMS – Energy Domains and Transducers – Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending – Torsional deflection.

Sensors and Actuators-I

Electrostatic sensors – Parallel plate capacitors – Applications – Inter-digitated Finger capacitor –Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph -

Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

Sensors and Actuators-II

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators –piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

Micromachining

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

Polymer and Optical MEMS

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS –Lenses and Mirrors – Actuators for Active Optical MEMS.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the micro fabrication process, MEMS materials and various system issues.

CO2: summarize the electrical and mechanical concepts of MEMS.

CO3: explain the optical MEMS and various case studies.

CO4: acquire knowledge on various types of micro sensors.

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson Education Inc., 2012.
2. Stephen D Senturia, “Microsystem Design”, Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture”, Tata McGraw Hill, New Delhi, 2002.
4. Thomas M. Adams and Richard A. Layton, “Introduction MEMS, Fabrication and Application”, Springer, 2010.
5. Nadim Maluf, “An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.

PROFESSIONAL ELECTIVES

ELECTIVE – V & VI GROUP

20ECP21	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the characteristics of wireless channels, the basic concepts of cellular architectures, various digital signaling schemes for fading channels and multipath mitigation techniques.

COURSE CONTENT:

Wireless Channels

Large scale path loss – Path loss models: Free Space and Two – Ray models – Link Budget design – Small scale fading – Parameters of mobile multipath channels – Time dispersion parameters Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

Cellular Architecture

Multiple Access techniques – FDMA, TDMA, CDMA – Capacity calculations – Cellular concept Frequency reuse – channel assignment– hand off– interference & system capacity – trunking & grade of service – Coverage and capacity improvement.

Digital Signaling for fading channels

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, Orthogonal Frequency Division Multiplexing – Cyclic prefix, Windowing, PAPR.

Multipath Mitigation Techniques

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms, Diversity Techniques, Error probability in fading channels with diversity reception, Rake receiver.

Multiple Antenna Techniques

MIMO systems – spatial multiplexing – System model – Pre-coding – Beam forming – transmitter diversity, receiver diversity – Channel state information-capacity in fading and non-fading channels.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the cellular system and signaling schemes for fading channels.

CO2: Choose an appropriate multipath mitigation technique and analyze their performance.

CO3: Analyze the various propagation mechanisms and examine its effect.

CO4: Elaborate a MIMO system with transmit/receive diversity and analyze their performance.

REFERENCES:

1. C. Y. Lee and William, "Mobile Cellular Telecommunications", 2ndEdition, McGraw Hill, 2011.
2. Theodore S Rappaport, "Wireless Communication Principles and Practice", 2ndEdition, Pearson Education, 2010.
3. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University, Press, 2ndEdition, 2010.
4. Andrea Goldsmith, "Wireless Communication", 2ndEdition, Cambridge University Press, 2012.
5. Kaveh Pahlavan and Prashant Krishnamurthy, "Principles of Wireless Networks", Pearson, 2011.

20ECP22	COGNITIVE RADIO	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the architecture of software defined radio, Cognitive radio, its optimization of radio resources and next generation wireless networks based on cognitive radio.

COURSE CONTENT:

Software Defined Radio

Evolution of Software Defined Radio - goals, benefits, definitions, architecture evolution- technology trade-offs - architecture implications - relation with other radios- issues - enabling technologies- radio frequency spectrum and regulations.

SDR Architecture

Essential functions of the software radio – basic SDR – hardware architecture – Computational processing resources – software architecture – top level component interfaces – interface topologies among plug and play modules.

Cognitive Radios

Making radio self–aware, cognitive techniques – position awareness – environment awareness in cognitive radios – optimization of radio resources – Artificial Intelligence Techniques.

Cognitive Radio Architecture

Cognitive Radio – functions – components and design rules – Cognition cycle – orient – plan – decide and act phases – Inference Hierarchy – Architecture maps – Building the Cognitive Radio Architecture on Software defined Radio Architecture.

Next Generation Wireless Networks

The XG Network architecture – spectrum sensing – spectrum management – spectrum mobility – spectrum sharing – upper layer issues – cross – layer design.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the basics of software defined radio.

CO2: Explain the essential functions of software radio.

CO3: Summarize the concept of wireless networks in cognitive radio.

CO4: Explain the next generation wireless networks for wireless applications

REFERENCES:

1. J. Mitola, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2014.
2. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, “Cognitive Radio Communications and Networks - Principles and Practice”, Elsevier Inc., 2010.
3. E. Biglieri, A. J. Goldsmith., L. J. Greenstein, N. B. Mandayam and H. V. Poor, “Principles of Cognitive Radio”, Cambridge University Press, 2013.
4. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons, Ltd, 2010.
5. Khattab, Ahmed, Perkins, Dmitri, Bayoumi and Magdy, “Cognitive Radio Networks – From Theory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2012

20ECP23	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the concepts of WLAN, WiMAX, WWAN, basics of 4G networks, its features, internetworking between different wireless networks and the concepts of LTE system. This course also focuses on the fundamental concepts of Mobile network and transport layer.

COURSE CONTENT:

Wireless LAN

Introduction-WLAN technologies: infrared, UHF narrowband, spread spectrum – IEEE802.11: system architecture, protocol architecture, physical layer, MAC Layer, 802.11b, 802.11a – HiperLAN: WATM, BRAN, HiperLAN2 – Bluetooth: architecture, radio layer, baseband layer, link manager protocol, security – IEEE802.16-WIMAX: physical layer, mac, spectrum allocation for WIMAX.

Mobile Network Layer

Introduction – Mobile IP: IP packet delivery, agent discovery, tunneling and encapsulation, IPV6-Network Layer in the Internet- Mobile IP session initiation protocol – Mobile Ad-Hoc network: routing, destination sequence distance vector, dynamic source routing.

Mobile Transport Layer

TCP enhancements for wireless protocols – traditional TCP: congestion control, fast retransmit/fast recovery, implications of mobility – classical TCP improvements: indirect TCP, snooping TCP, mobile TCP, time out freezing, selective retransmission, transaction oriented TCP – TCP over 3G wireless networks.

Wireless Wide Area Network

Overview of UMTS Terrestrial Radio Access Network-UMTS Core Network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, firewall, DNS/DHCP - High Speed Downlink Packet Access (HSDPA)- LTE Network Architecture and Protocol.

4G Network

Introduction – 4G vision – 4G features and challenges – applications of 4G – 4G technologies: multicarrier modulation, smart antenna techniques, OFDM-MIMO systems, adaptive modulation and coding with time slot scheduler, cognitive radio.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the system architecture of various wireless LAN technologies.

CO2: Analyze wireless network environments using wireless protocols and standards.

CO3: Analyze various wireless WAN technologies and to select appropriate access technique to achieve high speed communication.

CO4: Analyze different technologies of 4G network for gaining high data rate.

CO5: Assess the different network strategies for the development of smartphones and mobile devices applications

REFERENCES:

1. Jochen Schiller, "Mobile Communications", 2ndEdition, Pearson Education, 2012.
2. Vijay Garg, "Wireless Communications and Networking", 1stEdition, Elsevier, 2007.
3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", 2ndEdition, Academic Press, 2008.
4. Anurag Kumar, D. Manjunath, Joy Kuri, "Wireless Networking", 1stEdition, Elsevier 2011.
5. Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", 1st Edition, Pearson Education, 2013.

20ECP24	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the importance of security, security goals, integrity, authentication, hash functions and various security tools. This course focuses on the fundamental concepts of conventional encryption and decryption algorithms. Further, students will be able to understand the Network security, Firewalls and Wireless network security.

COURSE CONTENT:

Security

Security Goals – Types of attacks: Passive attack, Active attack, Attacks on confidentiality, Attacks on integrity and availability – Security services and mechanisms – Cryptography – Steganography – Revision on mathematics for cryptography.

Symmetric & Asymmetric Key Algorithms

Substitution ciphers – Transposition ciphers – Stream and block ciphers – Data Encryption Standards (DES) – Advanced Encryption Standard (AES) – RC4 – Principle of asymmetric key algorithms – RSA cryptosystem- Introduction to Elliptic Cryptography.

Integrity, Authentication and Key Management

Message integrity – Hash functions – SHA – Digital signatures – Digital signature standards – Authentication – Entity authentication – Biometrics – Key management techniques.

Network Security, Firewalls and Web Security

Introduction on firewalls – Types of firewalls – Firewall configuration and limitation of firewall – IP security overview – IP security architecture – Authentication header – Security payload – Security associations – Web security requirement – Secure sockets layer – Transport layer security – Secure electronic transaction – Dual signature.

Wireless Network Security

Security attack issues specific to wireless systems – Wormhole – Tunneling – DoS – WEP for Wi-Fi network – Security for 4G networks – Secure ad hoc Network – Secure sensor network.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the concepts of security threats, services and cryptographic algorithms.

CO2: Outline the concepts of network security, firewalls and web security

CO3: Infer the issues in wireless networks and its security solutions of wireless network

CO4: Apply various Cryptographic Algorithms to secure a communication system

CO5: Apply the techniques of hash functions and key management issues.

REFERENCES:

1. W. Stallings, “Cryptography and Network Security: Principles and Practice”, 5thEdition, Prentice Hall, 2013.

2. William Stallings, “Network Security Essentials: Applications and Standards”, Pearson Education, 4thEdition 2010.
3. Behrouz A. Forouzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, 2ndEdition, Tata McGraw Hill, 2011.
4. Atul Kahate, “Cryptography and Network security”, 3rd Edition, Tata McGraw- Hill, 2013.
5. Madhumita Panda, “Data security in wireless sensor networks via AES Algorithm”, Intelligent Systems and Control (ISCO), IEEE, 2015.

20ECP25	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the concepts of wireless sensor networks, Infrastructure, basics of Networking sensors, Network protocols and various issues in Routing.

COURSE CONTENT:

Overview of Wireless Sensor Network

Challenges for Wireless Sensor Networks – Characteristics requirements – Applications of sensor networks – Sensor Node Architecture – Hardware Components – Energy Consumption of Sensor Nodes – Network Architecture – Sensor Network Scenarios, Optimization Goals and Figure of Merit – Gateway Concepts.

Infrastructure Establishment

Topology Control – Clustering Types – High level overview Time Synchronization – Sensor Tasking and Control.

Networking Sensors

Physical Layer and Transceiver Design Considerations – MAC Protocols for Wireless Sensor Networks – Low Duty Cycle Protocols and Wakeup Concepts –Mediation Device Protocol – Wakeup Radio Concepts – Address and Name Management – Assignment of MAC Addresses – Routing Protocols – Energy Efficient Routing – Geographic Routing.

Network Protocols

Issues in Designing MAC Protocol for WSNs – Classification of MAC Protocols – S-MAC Protocol – B-MAC Protocol – IEEE 802.15.4 Standard and Zig Bee – Dissemination Protocol for Large Sensor Network.

WSN Routing, Localization & QOS

Issues in WSN routing– OLSR – Localization – Indoor and Sensor Network Localization – Absolute and relative localization – Triangulation – Localization and Positioning – QOS in WSN – Energy Efficient Design – Synchronization – Transport Layer issues.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the technologies and applications for the emerging domain of wireless sensor networks.

CO2: Explain various layers in the WSN protocol stack.

CO3: Analyze the Networking sensors for wireless applications

CO4: Explain different issues in WSN Routing and Quality of service.

REFERENCES:

1. Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks" John Wiley, 2010.
2. Fei Hu and Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", CRC Press, 2010.
3. Kazem, Sohraby, Daniel Minoli, TaiebZanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons, 2010.
4. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press, 2010.
5. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2013.

20ECP26	INTRODUCTION TO EMBEDDED CONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the architecture, programming, interfacing and communication protocols of PIC microcontroller.

COURSE CONTENT:

8-Bit Controller

Microprocessors and microcontrollers, introducing PIC 16F877- architecture, memory technologies, timing circuits, power-up and reset, parallel ports, ADC, interrupt, serial peripheral buses (UART, I2C, SPI), PWM, counters and timers, instruction set and assembly language programming.

16-Bit Controller

DsPIC30F microcontroller- architecture, DSP engine, memory, parallel ports, system and power management, ADC, interrupt, PWM.

PIC Development Tools and Programming

ARM processor, LPC2148, PIC89552, Software development tools- editor, assembler, compiler, cross-compiler and simulator, Hardware development tools- development board, device programmer, in-circuit emulator and debuggers. Embedded C Programming, data types and variables, data type modifiers, storage Class modifiers, C statements, structures and operations, pointers, libraries, in-line assembly programming, optimizing and testing embedded C programs, KEIL tool.

Multitasking and the Real-Time Operating System

The challenge of multitasking and real time, multitasking with sequential programming, State machines, Real time operating system, RTOS services, synchronization and messaging tools, CCS PIC C Compiler RTOS. Design example: Voltmeter with RS232 serial output.

Peripheral Interfacing with PIC Microcontroller

Human and physical interfaces- switches to keyboard, LED display, liquid crystal display, Actuators and sensors, PWM, serial communication protocols (UART, I2C, SPI), programming interrupt, timers and counter.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand PIC microcontroller based systems and its interfacing.

CO2: Analyse the digital signal processing operations using PIC microcontrollers.

CO3: Analyze and apply proper development tools for PIC microcontrollers.

CO4: Apply the concept of multitasking and RTOS in embedded system design.

REFERENCES:

1. David. E. Simon, “An Embedded Software Primer”, Addison-Wesley, Reprint 2015.

2. Kirk Zurell, “C programming for Embedded Systems”, CRC Press, 2016.
3. Dogan Ibrahim, “Advanced PIC microcontroller projects in C”, Newnes publication, 2012.
4. Tim Wilmshurst, “Designing Embedded Systems with PIC microcontrollers-Principles and Applications”, Newnes Publications, 2007.
5. Douglas V. Hall, “Microprocessor and Interfacing, Programming and Hardware”, Tata McGraw Hill Revised, 2nd Edition 2016, 11th Reprint 2011.
6. Muhammad Ali Mazidi, Rolin Mc Kinlay, Danny Causey, “PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18”, Prentice Hall publications, 2007.

20ECP27	ASIC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the semi and full custom IC Design, the principles of logic cells, I/O cells and interconnect architecture, simulation and testing aspects of FPGA and ASIC .

COURSE CONTENT:

ASIC design flow

Types of ASICs - ASIC physical design and Layout Rules, System Partitioning, Algorithms: K-L, FM, Simulated annealing algorithms.

Programmable ASIC Logic Cells

Anti fuse - static RAM - EPROM and EEPROM based ASICs - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

Programmable ASIC Architecture

Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze / NIOS based embedded systems – Signal probing techniques.

Placement and Routing, Full Custom

ASIC floor planning- placement and routing – power and clocking strategies, Global routing, Detailed routing, Special routing. Full Custom Basics, Needs and Applications.

Logic Synthesis, Simulation and Testing

Design systems - Logic Synthesis - Verilog and VHDL synthesis - Types of simulation - Boundary scan test - Fault simulation.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the standard ASIC / FPGA for VLSI applications.

CO2: Understand the Programmable Architecture and I/O cells of ASIC/FPGA for IC design.

CO3: Describe placement and routing procedures for ASIC design flow.

CO4: Explain the logical synthesis, simulation and testing aspects of ASIC design.

REFERENCES:

1. M.J.S.Smith, "Application - Specific Integrated Circuits", Pearson, 2003.
2. Paul M. Jr. Brown "A Guide to Analog ASICs" Academic Press, 2ndEdition. December 2012.
3. Roger Woods ,John McAllister, Ying Yi "FPGA based Implementation of Signal Processing Systems" John Wiley & Sons, 2ndEdition ,February 2017
4. Norman G. Einspruch, "Application Specific Integrated Circuit (ASIC) Technology" Elsevier Science, 2nd Edition, 2012.
5. Jose E. France, Yannis Tsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

20ECP28	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the basic concepts of Machine Learning, Supervised and Unsupervised learning techniques, various probability based learning techniques and graphical models of machine learning algorithms.

COURSE CONTENT:

Machine Learning Fundamentals

Machine learning -Examples of Machine Learning applications-Learning Associations-Classification Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization

Concept Learning and Decision-Tree Learning

Concept Learning - Concept learning Task – Concept Learning as search –Finding a maximally specific hypothesis – Version Spaces and Candidate elimination Algorithm – Inductive Bias Decision Tree Learning - Decision Tree representation –Problems for Decision Tree Learning –Hypothesis Search space – Inductive Bias in Decision Tree Learning – Issues in Decision Tree Learning

Multilayer Perceptrons and Deep Learning

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons-MLP as Universal Approximator- Back propagation Algorithm-Training Procedures Convolution Networks –The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior –Variants of the Basic Convolution Function –Structured Outputs – Data Types –Efficient Convolution Algorithms –Random and Unsupervised features

Clustering

Similarity-Based Clustering-Unsupervised learning problems-Hierarchical Agglomerative Clustering (HAC)-Single-link, complete-link, group-average similarity- k-Means and Mixtures of Gaussians-Flat clustering-K-Means algorithms-Mixture of Gaussian model-EM-algorithm for mixture of Gaussian model

Reinforcement Learning

Introduction – learning task – Q learning – The Q function – Algorithm for Q learning – convergence – experimentation strategies – updating sequence –Non deterministic rewards and actions –Temporal difference learning –Generalizing from examples –relationship to dynamic programming

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand various learning techniques like decision tree, Analytical, Inductive and reinforced learning.

CO2: Apply the appropriate machine learning techniques for classification, Pattern recognition.

CO3: Apply appropriate machine learning techniques for optimization and decision problems

CO4: Apply Computational intelligence for appropriate machine learning techniques

REFERENCES:

1. Ethem Alpaydin, “Introduction to Machine Learning”, The MIT Press, September 2014, ISBN 978- 0-262-02818-9.
2. Mitchell, Tom, “Machine Learning”, New York, McGraw-Hill, First Edition, 2003.
3. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press Book.
4. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
5. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press (MA) 2012.

20ECP29	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the fundamental concepts of machine learning and deep learning techniques, deep learning models for extracting high level abstract features.

COURSE CONTENT:

Machine Learning Fundamentals

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression) - Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

Deep Learning Fundamentals

History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks -Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.

Deep Learning Models

Long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, learning from descriptions, attention. Deep generative models Auto-encoders, variational auto-encoders, generative adversarial networks,

autoregressive models, generative image models, unsupervised and self-supervised representation learning.

Dimentionality Reduction

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization

Applications of Deep Learning

Function approximation algorithms for reinforcement learning - Natural Language Processing - Virtual Assistants - Visual Recognition - Case studies of reinforcement learning applications that have achieved superhuman performance

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the fundamental concepts of Machine Learning and Deep learning.

CO2: Explain various deep learning models.

CO3: Analyze the concept of high dimensional data using reduction techniques.

CO4: Apply the deep learning algorithms for various applications.

REFERENCES:

1. Miroslav Kubat, “An Introduction to Machine Learning”, Springer, 2017.
2. Ian Good fellow, Yoshua Bengio, Aaron Courville, “Deep Learning” MIT Press.2016.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning”, Springer International Publishing, 2018.
4. Dino Esposito, Francesco Esposito, “Introducing Machine Learning”, Pearson, 2020.
5. Jon Krohn, Grant Beyleveld, Aglaé Bassens, “Deep Learning Illustrated”, Pearson Education, 2019.

20ECP30	COGNITIVE ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand robot cognition and perception, concepts of path planning algorithms and to gain knowledge on the robot programming packages used in localization and mapping.

COURSE CONTENT:

Cybernetic View of Robot Cognition and Perception

Introduction to Robotics - Introduction to the Model of Cognition - Visual Perception - Visual Recognition- Machine Learning - Soft Computing Tools and Robot Cognition.

Map Building

Introduction - Constructing a 2D World Map, Data Structure for Map Building - Explanation of the Algorithm - An Illustration of Procedure Traverse Boundary - An Illustration of Procedure Map Building - Robot Simulation - Execution of the Map Building Program.

Randomized Path Planning

Introduction - Representation of the Robot's Environment - Review of configuration spaces - Visibility Graphs - Voronoi diagrams - Potential Fields and Cell Decomposition - Execution of the Quad tree-Based Path Planner Program.

Simultaneous Localization and Mapping (SLAM)

Problem Definition, Mathematical Basis, Examples: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter - Graph-Based Optimization Techniques - Particle Methods Relation of Paradigms.

Robot Programming Packages and Imaging Geometry

Robot Parameter Display - Program for BotSpeak - Program for Sonar Reading Display, Program for Wandering within the Workspace - Program for Tele-operation, A Complete Program for Autonomous Navigation. – Imaging Geometry.

COURSE OUTCOMES:

At the end of the course student will have the ability to,

CO1: Understand the basics of robot cognition and perception.

CO2: Analyze the various path planning techniques by briefing about the robot's environment and programs.

CO3: Explain the various robot programming packages for display, tele -operation and other applications.

CO4: Apply Imaging Techniques for Robotics.

REFERENCES:

1. Patnaik, Srikanta, "Robot Cognition and Navigation - An Experiment with Mobile Robots", Springer Verlag Berlin and Heidelberg, 2007.

2. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, “Principles of Robot Motion-Theory, Algorithms, and Implementation”, MIT Press, Cambridge, 2005.
3. Sebastian Tharun, Wolfram Burgard, Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.
4. Margaret E. Jefferies and Wai-Kiang Yeap, “Robotics and Cognitive Approaches to Spatial Mapping”, Springer-Verlag Berlin Heidelberg 2008.
5. Hooman Somani, “Cognitive Robotics”, CRC Press, 2015.
6. Jared Kroff, "Cognitive Robotics: Intelligent Robotic Systems”, Wilford Press, 2016.
7. Lidia Ogiela, Marek Ogiela, “Advances in Cognitive Information Systems”, Springer, 2012.

20ECP31	TESTING OF VLSI CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand the testing of VLSI Circuits, the testing algorithms and various fault diagnosis techniques.

COURSE CONTENT:

TESTING AND FAULT MODELLING

Introduction to testing – Faults in Digital Circuits – Modelling of faults – Logical Fault Models –Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation –Delay models – Gate Level Event driven simulation.

TEST GENERATION

Test generation for combinational logic circuits – Testable combinational logic circuit design – Test generation for sequential circuits – design of testable sequential circuits.

SELF TEST AND TEST ALGORITHMS

Built-In self-test – test pattern generation for BIST – Circular BIST – BIST Architectures – Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs

FAULT DIAGNOSIS

Logical Level Diagnosis – Diagnosis by UUT reduction – Fault Diagnosis for Combinational Circuits– Self-checking design – System Level Diagnosis.

COURSE OUTCOMES:

At the end of the course, student should have the ability to,

CO1: understand the testing and fault modelling in VLSI circuits.

CO2: choose an appropriate testable combinational logic circuit and sequential circuit design

CO3: analyze various self-test and test algorithms and examine its testability.

CO4: elaborate fault diagnosis at logical level and system level and analyze their performance.

REFERENCES:

1. A.L.Crouch, "Design Test for Digital IC"s and Embedded Core Systems", Prentice Hall International, 2002.
2. M.Abramovici, M.A.Breuer and A.D. Friedman, "Digital systems and Testable Design", Jaico Publishing House, 2002.
3. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers, 2002.
4. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.

20ECP32	RECONFIGURABLE ARCHITECTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

This course will enable the students to understand application specific processors, various reconfigurable architectures, the programming technologies of FPGA and various routing for FPGAs.This course also focusses on various high design tools for Simulation and Synthesis.

COURSE CONTENT:

INTRODUCTION

Domain-specific processors, Application specific processors, Reconfigurable Computing Systems – Evolution of reconfigurable systems – Characteristics of RCS advantages and issues. Fundamental concepts & Design steps –classification of reconfigurable architecture-fine, coarse grain & hybrid architectures – Examples

FPGA TECHNOLOGIES & ARCHITECTURE

Technology trends- Programming technology- SRAM programmed FPGAs, anti fuse programmed FPGAs, erasable programmable logic devices. Alternative FPGA architectures: Mux Vs. LUT based logic blocks – CLB vs. LAB Vs. Slices- Fast carry chains- Embedded RAMs- FPGA Vs. ASIC design styles.

ROUTING FOR FPGAS

General Strategy for routing in FPGAs- routing for row-based FPGAs – segmented channel routing, definitions- Algorithm for I segment and K segment routing – Routing for symmetrical FPGAs, Flexibility of FPGA Routing Architectures: FPGA architectural flexibility on Routability- Effect of switch block flexibility on routability - Tradeoffs in flexibility of S and C blocks

HIGH LEVEL DESIGN

FPGA Design style: Technology independent optimization- technology mapping- Placement. High level synthesis of reconfigurable hardware, high- level languages, Design tools: Simulation (cycle based, event driven based) – Synthesis (logic/HDL Vs physically aware) – timing analysis (static Vs dynamic)-verification physical design tools.

COURSE OUTCOMES:

At the end of the course, student should have the ability to,

CO1: understand the Application specific processors, Reconfigurable Computing Systems

CO2: choose an appropriate FPGA technology and architecture for various application

CO3: analyze various routing in FPGAs and examine its routability.

CO4: analyze various FPGA designs styles using various design tools for simulation and synthesis.

REFERENCES:

1. Christophe Bobda, “Introduction to Reconfigurable Computing –Architectures, Algorithms and Applications”, Springer, 2010.
2. Clive “Max” Maxfield, “The Design Warrior‟s Guide to FPGAs: Devices, Tools And Flows”, Newnes, Elsevier, 2006.
3. Maya B. Gokhale and Paul S. Graham, “Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays”, Springer, 2005.
4. Russell tessier and Wayne Burleson “Reconfigurable Computing for Digital Signal Processing: A Survey” Journal of VLSI Signal processing, vol 28,pp 7-27,2001.
5. Stephen M. Trimberger, “field – programmable Gate Array Technology” Springer,2007.
6. Scott Hauck and Andre Dehon (Eds.), “Reconfigurable Computing –The Theory and Practice of FPGA-Based Computation”, Elsevier / Morgan Kaufmann, 2008.

OPEN ELECTIVES

(Offered by CSE Department to other B.E. Programmes)

20CSE01	BASICS OF PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of algorithmic problem solving, read and write simple Python programs and to develop Python programs with Python data structures namely lists, tuples, and dictionaries.

COURSE CONTENT:

Introduction

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

Python Basics

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments.

Control Structures and Strings

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Lists and Tuples

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.

File Handling and Exceptions

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: develop algorithmic solutions to solve various computational problems

CO2: structure simple python programs for solving problems.

CO3: create applications written using simple Python programs.

REFERENCES:

1. Anita Goel and Ajay Mittal "Computer Fundamentals and Programming in C", Pearson Education, 2013(Unit 1)
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) (Units 2,3,4 and 5).
3. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
5. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
6. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

20CSE02	INTRODUCTION TO AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The objective of the course is to learn the concepts of Artificial Intelligence and to understand the various characteristics of intelligent agents, the different search strategies in AI and represent knowledge for solving AI problems.

COURSE CONTENT:

Introduction

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem Solving Methods

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems -Searching with Partial Observations – Constraint Satisfaction Problems.

Knowledge Representation

First Order Predicate Logic – Inference in FOL – Unification – Forward Chaining - Backward Chaining – Resolution.

Learning

Learning- Learning from Examples: Forms of Learning – Theory of Learning - Decision Trees - Explanation-Based Learning - Reinforcement Learning: Active - Passive.

AI Applications

Expert Systems: Architecture - DART - MYCIN- Robotics: Hardware – Robotic Perception – Planning - moving.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: understand the basic concept of Artificial Intelligence.

CO2: apply appropriate search algorithms for any AI problem.

CO3: represent a problem using first order and predicate logic.

CO4: apply AI techniques in developing real world applications.

REFERENCES:

1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence - A Modern Approach", Third Edition, Pearson Publishers, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", Third Edition, Tata McGraw-Hill Education, 2008.
3. Dr. S N Sivanandam, Dr. M Paulraj," Introduction to Artificial Networks", Vikas Publishing House, India-2014.
4. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly, 2009, https://www.nltk.org/book/.
5. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
6. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

ONLINE RESOURCES:

1. NPTEL, "Artificial Intelligence", http://nptel.ac.in/courses/106105079/2.
2. Udacity, "Introduction to Artificial Intelligence".
3. https://www.coursera.org/learn/introduction-to-ai#syllabus.

20CSE03	FUNDAMENTALS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will introduce the rapidly growing field of data science and equip the students with some of its basic principles and tools as well as its general applications.

COURSE CONTENT:

Introduction

What is Data Science? Big Data and Data Science – Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices - Intro to R/ Python.

Data preprocessing

Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization-Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves - The Data Science Process.

Basic Machine Learning Algorithms

Association Rule mining - Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes. Feature Generation and Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.

Clustering

Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality.

Data Visualization

Basic principles, ideas and tools for data visualization.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: describe what Data Science is and the skill sets needed to be a data scientist.

CO2: explain in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data.

CO3: use R to carry out basic statistical modeling and analysis.

CO4: explain the significance of exploratory data analysis (EDA) in data science.

REFERENCES:

1. Cathy O'Neil and Rachel Schutt, “Doing Data Science, Straight Talk from The Frontline”, O'Reilly, 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining: Concepts and Techniques”, Third Edition. ISBN 0123814790, 2011.
3. Mohammed J. Zaki and Wagner Miera Jr, “Data Mining and Analysis: Fundamental Concepts and Algorithms”, Cambridge University Press, 2014.
4. Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, O'Reilly, 2016.
5. Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015.
6. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O'Reilly Media, 2012.

20CSE04	BASICS OF INTERNET PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basics of HTML5, CSS3 and JavaScript essential for website development. Also, to learn the basics of PHP and XML essential for the development of dynamic websites.

COURSE CONTENT:

Introduction to World Wide Web and HTML5

Web Basics – Multitier Application Architecture – Client-Side Scripting versus Server-Side Scripting – HTML5: Introduction – Editing HTML5 – Headings – Linking – Images – Special Characters – Horizontal Rules – List - Tables – Forms – Form Input Types

Cascaded Style Sheets

Introduction – Inline styles – Embedded styles – linking external styles – Conflicting styles – Absolute and Relative Positional Elements – Backgrounds – Box Model – Text flow – linear gradient – radial gradient

Client-Side Programming: JavaScript

Displaying a line of Text – User input with prompt dialogs – Arithmetic – Control Statements – if, if- else, while – for – switch – do…while – break and Continue – logical operators – Function Definitions – Scope Rules – Global functions – Declaring and Allocating Arrays - Example Arrays - Modelling a Document: DOM Nodes and Trees – Traversing and

Modifying DOM Tree - load Event – Event mouse move and the event Object – Form processing with Events.

Server-Side Programming: PHP

Introduction – Converting between data types – Operators – Arrays – String Comparison – Form Processing and Business Logic – Reading from a database – Using Cookies and Session

XML

XML Basics – Structuring Data – XML Namespaces – W3C XML Schema Documents - Ajax web Application – Ajax example using XML Http Request Object.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: design and develop a static website with latest W3C standards

CO2: design and develop an interactive website with client-side programming

CO3: design and develop a dynamic web page / web application with database access and session management.

REFERENCES:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Prentice Hall, 5th Edition, 2012.
2. Jeffrey C. Jackson, Web Technologies A Computer Science Perspective, 1st edition, Pearson Education, 2011.
3. Chris Bates, Web Programming: Building Internet Applications, 3rd Edition, Wiley India Pvt. Limited, 2007.
4. Robert W. Sebesta, Programming the World Wide Web, 7th Edition, Pearson, 2013.
5. Eric Freeman, Elisabeth Robson, Head First HTML5 Programming, Building Web Apps with JavaScript, 1st Edition, O'Reilly Media, Incorporated, 2011.
6. Jason Hunter, William Crawford, Java Servlet Programming, 2nd Edition, O'Reilly Media, 2010.

20CSE05	INTRODUCTION TO SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course focuses on the various soft computing frame works and familiarize with the design of neural networks, fuzzy logic and fuzzy systems and also to learn the mathematical background for optimized genetic programming.

COURSE CONTENT:

Introduction

Introduction to Soft computing - Basic tools of Soft Computing - Soft Computing vs Hard Computing -Artificial Neural Networks -Classification of ANNs.

Artificial Neural Networks

Back propagation Neural Networks – Associative memory neural networks - Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks.

Fuzzy Systems

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets – Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification – Fuzzy Arithmetic.

Genetic Algorithms

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction - Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator – Bit-wise Operators -Convergence of Genetic Algorithm.

Optimization Techniques

Multi objective Evolutionary Algorithms (MOEA) - Particle swarm optimization (PSO)- Ant Colony Optimization - Fire fly Optimization.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: apply the various soft computing concepts for solving real time problems.

CO2: apply the fuzzy rules and reasoning to develop decision making and expert system.

CO3: improve solution by optimization techniques.

REFERENCES:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.

2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

OPEN ELECTIVES

(Offered by EEE Department to other B.E. Programmes)

20EEE01	ENERGY MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to study the concepts behind energy management and auditing, economic analysis and Load management, the energy management on various electrical equipment and metering and to illustrate the concept of lighting systems and cogeneration.

COURSE CONTENT:

Introduction

Definition for energy management - Need for energy management - energy basics - designing and starting an energy management program - energy accounting -energy monitoring, targeting and reporting - Definition for Energy Audit – Types of energy audit.

Energy Cost and Load Management

Important concepts in an economic analysis - Economic models-Time value of money - Utility rate structures - cost of electricity - Loss evaluation. Load management: Demand control techniques - Utility monitoring and control system - HVAC and energy management - Economic justification.

Energy Efficiency in Electrical Utilities

Electricity billing – power factor improvement and benefits – transformers – Distribution losses in industrial system – energy efficient motors and factors affecting motor efficiency – star operations of motor – soft starters with energy saver – standards and labelling for motors.

Metering for Energy Management

Relationships between parameters - Units of measure - Typical cost factors - Utility meters – Smart meters - Demand meters - Paralleling of current transformers – Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples - Power Balancing & Metering: from grid, Solar to gird

Lighting Systems & Cogeneration

Concept of lighting systems - The task and the working space -Light sources - Ballasts - luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration – feasibility of cogeneration- Electrical interconnection.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the basics of energy management with respect to economic and social maters.

CO2: Apply the concepts of energy management in various electrical energy applications.

CO3: Analyze the energy calculation and statistics for improving the efficiency in industries, commercial and domestic applications.

REFERENCES:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Book III - Energy efficiency in electrical utilities, Second Edition 2018, By Bureau of Energy Efficiency, Ministry of Power, India.
5. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.

20EEE02	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to impart knowledge about the basic concepts of bio medical engineering and about sensors, electrodes and their applications in medical fields.

COURSE CONTENT:

Fundamentals of Biomedical Engineering

Introduction to biomedical Engineering - Development of Bio medical instrumentation – Biometrics – Introduction and Components of man vs Instrument system – physiological system of the body – problems in measuring living system – Sources of biomedical signal – Basic medical instrumentation system – Intelligent Medical Instrumentation system – Regulation of medical devices.

Bio Electric Signals and Electrodes

Origin of Bio electric signals – ECG – EEG – EMG – Electrodes for ECG - Electrodes for EEG - Electrodes for EMG – Electrical conductivity of Electrode jellies and creams – Micro electrodes – Electrode and Electrolyte interface – polarization.

Physiological Transducers

Introduction to transducers – classifications of transducers – Performance characteristics of transducer – Displacement transducers – Motion transducers – Position transducers –

Pressure transducer – temperature measurement transducer – Photoelectric transducer – Bio sensors – Smart sensors.

Recording Modern Imaging System

ECG recorder – VCG recorder – PCG recorder – Digital Stethoscope – EEG – Electromyography – Central monitors – Heart and blood pressure measurement - Basis of Diagnostic Radiology – X-ray machine - Visualization of X-Rays - Portable and Mobile X-Ray Units – Digital X-ray System.

Bio Amplifier and Patient Safety

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference - Electric Shock Hazards - Leakage Currents - Safety Codes For Electro medical Equipment - Electrical Safety Analyser - Testing Of Biomedical Equipment.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Remember the basic concepts in bio medical engineering.
CO2: Understand the concept of various sensors, meters and recording devices used in the medical fields.
CO3: Apply this bio-electrical and bio-electronic device to identify the various diseases.

REFERENCES:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
3. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
4. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGrawHill Publisher, 2003.
5. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.

20EEE03	PLC PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the operating and selection procedures of a PLC for industrial systems and possess knowledge levels to program a small, automated industrial production line.

COURSE CONTENT:

Introduction

Programmable Logic Controller- History of PLC, Difference between PC & PLC, Architecture of PLC, Advantages and Disadvantages, Overall PLC system, PLC cycle Application.

Programmable Logic Controller

PLC as a computer, Programming format, PLC Modules - Input on/off Switching Devices, Input Analog Devices, Output on/off Switching Devices, Output Analog Devices.

PLC Programming

Relay Logic, Coils and Indicators, Ladder Diagram, PLC Input Instructions, PLC Programming Examples, Industrial Process Example.

PLC Functions

PLC Registers – Input, Output, Holding, Module Addressing, PLC Timer functions, PLC Counter Functions, PLC Arithmetic Functions, and Industrial Application Examples.

Selection, Maintenance and Application

Factors in Selecting a PLC, Electrical Connections, Troubleshooting malfunctions, Maintenance. Applications – Water Filling Station, Industrial Three-axis Robot Control, PID controller using PLC.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the electrical relay logic and ladder logic.

CO2: Identify the correct PLC for an industrial system.

CO3: Design ladder logic for small industrial applications.

REFERENCES:

1. John W Webb, Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella, “Programmable Logic Controllers ", McGraw Hill Inc, 2005.
3. Kelvin T Erikson, “Programmable Logic Controllers”, Dogwood Valley Press, 2005.
4. Garry Duning, “Introduction to Programmable Logic Controller”, Cengage Learning, 3rd Edition, 2006.
5. W. Bolten, “Programmable Logic Controller”, Elsevier Newness Publication, 5th Edition, 2009.

20EEE04	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to study about renewable Energy Sources and technologies, learn adequate inputs on a variety of issues in harnessing renewable Energy and to recognize current and possible future role of renewable energy sources.

COURSE CONTENT:

Renewable Energy (RE) Sources

Environmental consequences of fossil fuel use - Importance of renewable sources of energy - Sustainable Design and development - Types of RE sources - Limitations of RE sources - Present Indian and international energy scenario of conventional and non-conventional sources.

Wind Energy

Power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs-Working of WPPs - Siting of WPPs - Grid integration issues of WPPs.

Solar PV and Thermal Systems

Solar Radiation - Radiation Measurement - Solar Thermal Power Plant - Central Receiver Power Plants - Solar Ponds.- Thermal Energy storage system with PCM - Solar Photovoltaic systems - Types of PV Systems - Types of Solar Cells - Cell, module - array - PV Module - I-V Characteristics - series and parallel connections, maximum power point tracking - Applications. Practical usage: Direct supply, Balance Supply Balance Supply needs temporary storage – Batteries fly wheel system (mechanical) based energy optimization

Biomass Energy

Introduction - Bio mass resources - Energy from Bio mass: conversion processes - Biomass Cogeneration - Environmental Benefits. Geothermal Energy: Basics - Direct Use - Geothermal
Electricity - Mini/micro hydro power: Classification of hydropower schemes - Classification of
water turbine - Turbine theory - Essential components of hydroelectric system.

Other Energy Sources

Tidal Energy: Energy from the tides - Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves - wave power devices. Ocean Thermal Energy Conversion (OTEC) - Hydrogen Production and Storage - Fuel cell: Principle of working - various types - construction and applications. Energy Storage System - Hybrid Energy Systems.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concept of conventional, non-conventional energy sources and solar, wind, biomass, biogas power generation.

CO2: Understand the concept of energy conversion of solar, wind, biomass, biogas, hydrogen cell, fuel cell, Geo thermal, Ocean thermal, Tidal and Wave energy.

CO3: Apply the concept of energy conversion techniques for the betterment of power generation and power system.

REFERENCES:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt., Ltd, New Delhi, 2013.
3. A.K.Mukerjee and Nivedita Thakur, "Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011.
4. Chetan Singh Solanki, "Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011.
5. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.

20EEE05	VIRTUAL INSTRUMENTATION AND DATA ACQUISITION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to impart the knowledge about software and programming structure of LabVIEW and to introduce various techniques of interfacing with external instruments of PC.

COURSE CONTENT:

Introduction to Virtual Instrumentation

Introduction - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Virtual Instruments – Data flow techniques, graphical programming in data flow, comparison with conventional programming.

Graphical Programming

Front panel - Block diagram - VIs - Sub-VIs - Simple examples - Looping: For loop, while loop - Shift registers - case and sequence; structures, formula nodes. Arrays - Clusters, charts and graphs - Local and global variables - Property node, string and file I/O.

Data Acquisition

DAQ – Components - Buffers - Triggering - Analog I/O - Digital I/O - Counters and timers - DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Instrument Control

VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI. PXI system controllers - Ethernet control of PXI. Industrial applications- VISA and IVI.

Application of Virtual Instrumentation

Simulation of systems using VI: Development of Control system - Industrial Communication- Image acquisition and processing - Motion control.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the fundamental programming and dataflow in virtual Instrumentation using various data structures, program structures.

CO2: Understand the fundamental programming and dataflow in virtual Instrumentation using various plotting the graphs and charts for system monitoring, processing and controlling.

CO3: Apply the concept of network interface for data communication using Data Acquisition systems.

CO4: Analyze the tools and to create graphical programming for automation, control applications, real time signal acquisition and analysis

REFERENCES:

1. Jane W. S. Liu," Real-time Systems", Pearson Education, 2001.
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", Prentice Hall of India, New Delhi, 2011.
3. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, 1997.
4. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement", Instrumentation and Control, Newnes, 2000.
5. Gupta S and Gupta J P, "PC Interfacing for data acquisition and Process control", Instrument Society of America.

20EEE06	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to impart knowledge about the basic concepts and terminologies, energy storage devices used to drive and power the hybrid electric vehicles, different charging technologies and the control units available in the market area.

COURSE CONTENT:

Introduction

History of EV – basics of EV - Components in EV – Hybrid Electric Vehicles - Fuel Cell Vehicles - Recent EVs and HEVs – efficiency comparison – pollution comparison – advantages of EV.

Vehicle Mechanics and Regenerative Braking

General Description of Vehicle Movement - Vehicle Resistance - Dynamic Equation - Tire–Ground Adhesion and Maximum Tractive Effort - Power Train Tractive Effort and Vehicle Speed - Vehicle Power Plant and Transmission Characteristics – EV Vehicle Performance - Tractive Effort in Normal Driving – Energy Consumption – fundamentals of regenerative braking.

Electric Propulsion Systems and Design of Series and Parallel HEV

DC Motor Drives - Induction Motor Drives – PMBLDC motors – SRM drives – Series HEV: Operation Patterns - Control Strategies - Sizing of the Major Components – Parallel HEV: Control Strategies of Parallel Hybrid Drive Train - Design of Drive Train Parameters - Mild Hybrid Electric Drive Train Design.

Energy Storage System

Battery Basics – Li-ion Battery - Cell Discharge Operation - Cell Charge Operation – Construction - Alternative Batteries - Battery Parameters - Technical Characteristics - Practical Capacity - Battery Power - Ragone Plots - Targets and Properties of Batteries - Battery Modelling – Ultra capacitors - Ultrahigh-Speed Flywheels - Hybridization of Energy Storages.

Charging Station and BMS

EV charging standards - various methods of charging – battery swapping - V2G - G2V- V2B - V2H - integration of EVs in smart grid – Introduction to BMS

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: remember the basic concepts in Electric and hybrid electric vehicles.
CO2: understand the concept of vehicle dynamics, prime movers, energy storage device and various sensors Electric and hybrid electric vehicles.
CO3: apply control units concepts in Electric and hybrid electric vehicles to improve the vehicle efficiency.

REFERENCES:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003.
2. Husain, I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2010.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.

OPEN ELECTIVES

(Offered by IT Department to other B.E. Programmes)

20ITE01	BIG DATA ANALYTICS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to understand the basics of big data analytics, Hadoop, and gain knowledge about the different data analytics techniques and its applications.

COURSE CONTENT :

Introduction to Big Data

Introduction – distributed computing – Need of distributed computing for Big Data– Evolution of data management–Understanding the data – Defining big data – characteristics of Big Data – Big Data and its importance– Big Data analytics–Traditional and advanced analytics. Big Data Types - Structured data - Unstructured data - Semi structured data.

Introduction to Hadoop

Big Data – Apache Hadoop & Hadoop Ecosystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of Map Reduce - Data Serialization.

Introduction to MongoDB

What is MongoDB? – Why Mongo DB? – Terms used in RDBMS and MongoDB – Data Types in MongoDB – MongoDB Query Language.

Big Data Trends

Data Curators – CDOs are stepping up – Dark data in the cloud – Streaming the IoT for machine learning - Edge Computing – Open Source – chatbots will get smarter – Container Revolution - Commoditization of visualization.

Big Data Applications

Big Data in Health care – Big Data contributions to Education - Big Data contributions to Insurance Services - Big Data Contributions to Industrial and Natural Resources - Big Data Contributions to Transportation - Big Data Contributions to Banking Zones and Fraud Detection.

COURSE OUTCOMES :

At the end of the course student should have the ability to,

CO1: Understand the fundamental concepts of Big Data

CO2: Demonstrate the deployment of Hadoop and Map reduce in a Big Data Environment

CO3: Understand the usage of Mongo DB in data analytics.

CO4: Compare the various data platforms with IoT and Cloud based on evaluation parameters.

CO5: Understand the application of big data analytics in real-time scenarios

REFERENCES :

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", 2nd Edition, Wiley India Pvt Ltd, 2021.
2. Chris Eaton, Dirk deroos, "Understanding Big data", McGraw Hill, 2012.
3. Judith Hurwitz, Alan Nugent et al.," Big Data for Dummies", John Wiley & Sons, Inc, 2013
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing, 2013.
5. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.

20ITE02	CLOUD COMPUTING FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the basic concepts, Cloud Models, architecture of cloud computing and techniques of virtualization and also get familiarized with the cloud platforms.

COURSE CONTENT:

Cloud Computing and Cloud Services

Introduction to Cloud Computing - History of Cloud computing - Types of Clouds - Characteristics of Cloud Computing - Cloud Architecture - Cloud Storage - Cloud Services - Benefits from Cloud Computing - Pros and Cons of Cloud Computing - Applications of Cloud Computing. Web based applications - Advantages of cloud development - Disadvantages of cloud development - Types of Cloud Service Development: Software as a Service - Platform as a Service - On demand Computing - Discovering Cloud services development services and tools.

Virtualization Technology and Services

Introduction - Virtualization Defined - Virtualization benefits - Server Virtualization - Virtualization for x86Architecture - Hypervisor Management Software - Virtual

Infrastructure Requirements. Exploring Online Calendar Applications: Google Calendar - Yahoo Calendar - Windows Live Calendar - Apple MobileMe calendar - Exploring Online Scheduling Applications - Exploring Online Planning.

Collaborating with Cloud

Evaluating Web mail services - Evaluating Instant Messaging Services - Evaluating Web Conferencing Tools – Collaborating via social networks and group ware - Collaborating on budgets.

Web Services

Introduction - Amazon Web Services - Google App Engine – Microsoft Azure – Cloud computing economics - AJAX and Mashups.

Security in Cloud Computing

Cloud Computing software security Fundamentals : Cloud Security Services, Cloud Security Design Principles - Security Challenges Concerns, Risk Issues, and Legal Aspects - Security Requirements for the Architecture

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Apply cloud computing techniques to solve large scale scientific problems.

CO2: Implement virtualization for applications, desktops, servers, and network platforms.

CO3: Develop a cloud application with a user interface and understand data components.

CO4: Apply the various cloud platforms to develop and deployment for web application.

CO5: Understand the security aspects and architecture that are considering to protect cloud systems

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, “Mastering Cloud Computing”, First Edition ,McGraw Hill Publications, 2013.
2. Michael Miller, “Cloud Computing: Web-Based Applications that Change the way you Work and collaborate Online’, Pearson publications Aug 2008.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things”, First Edition Morgan Kaufmann Publisher, an imprint Elsevier 2012.
4. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, Publisher: CRC Press, September 2013.
5. Graham Speake, Vic (J.R.) Winkler, “Securing the Cloud: Cloud Computer Security Techniques and Tactics”, Elsevier, USA, 2011.

20ITE03	FUNDAMENTALS OF INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This Course will enable the students to understand the basic concepts of Internet of Things, Elements involved in Internet of Things, Physical Devices of IoT,Data Analytics in IoT and Explore the various real-time applications which can be automated using Internet of Things.

COURSE CONTENT:

Fundamentals of IoT

Introduction - Definition and Characteristics of IoT - Physical design - IoT Protocols - Logical design - IoT communication models, IoT Communication APIs - Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs - IoT Architectural view - IoT and M2M- difference between IoT and M2M - IoT systems management – Needs - NETCONF, YANG - IoT design methodology

Elements of IoT

Sensors and actuators - Communication modules – Zigbee - LoRa - RFID - Wi-Fi - Power sources-IoT platforms - Cloud Computing in IoT - Cloud Connectivity - Big Data Analytics-Data Visualization.

IoT Physical Devices and Endpoints

Basic Building Blocks of IoT Device - Raspberry Pi – About the Board – Linux on Raspberry Pi - Raspberry Pi interfaces – Introduction Django framework – Designing a Web RESTful API - Other IoT devices – Introduction to Arduino.

Data Analytics for IoT

Introduction – Apache Hadoop – Using Hadoop MapReduce for Batch data analysis – Apache Spark – Apache Storm – using Apache Storm for Real time data analytics.

Challenges in IoT and Case Studies

Security Concerns and Challenges - Real time applications of IoT – Home automation Cities – Environment – Energy – Agriculture – Industry – Health and Lifestyle.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the fundamental concepts of Internet of Things.

CO2: Demonstrate the integration IoT elements with various technologies.

CO3: Understand the building blocks of Internet of Things and characteristics

CO4: Understand the relationship between IoT and Data analytics.

CO5: Understand the application of IoT in real-time scenarios.

REFERENCES :

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd Edition, 2013.
3. Raj Kamal, “Internet of Things – Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017.
4. Internet of Things and Data Analytics, HwaiyuGeng, P.E, Wiley Publications, 2017.
5. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013.

20ITE04	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to learn the basic concepts of DBMS, ER Diagrams, Relational model, transaction processing, and Familiarized with the various queries that can be used for data retrieval.

COURSE CONTENT:

Introduction to DBMS

Overview - Purpose of Database System -– Views of data – Data Models – Database Languages — Database System Architecture – Database users and Administrator - Data Models – Introduction to relational databases

Relational Model

Entity-Relationship Diagram-Design Issues- Weak Entity Sets- and Extended E-R features - Structure of relational Databases- Views- Modifications of the Database – Keys.

SQL Fundamentals

Concept of DDL- DML- TCL - DCL: Basic Structure- Set Operations- Aggregate Functions- Null Values- Domain Constraints- Referential Integrity Constraints- CODD’s Rule - Functional Dependency- Different Anomalies in designing a Database - Normalization.

Data Storage, Querying and Transaction Management

RAID – Indexing – Query optimization and Processing – transaction Concept – ACID Properties – Serializability – Transactions as SQL statements.

Database Applications

Proprietary DBMS vs Open Source DBMS –NoSQL – Databases for Social Networks – Introduction to Multimedia Databases.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Describe the most common designs for core database system components CO2: Apply the modeling concepts and notation of the relational data model

CO3: Create a relational database schema in SQL that incorporates key, entity integrity, and referential integrity constraints.

CO4: Understand the various transaction processing, transaction models, storage management techniques and indexing techniques.

CO5: Understand the various types of databases that are used in social networks.

REFERENCES :

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill Education India Pvt. Ltd., 2016.
2. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
3. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi, 2003.
4. Raghu Ramakrishnan, "Database Management Systems",McGraw-Hill, third Edition,2014.
5. Bipin C Desai, "An Introduction to Database Systems", Galgotia Publications Pvt., Limited, Revised edition 2012.

20ITE05	WEB INTERFACE DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students to understand the basic concepts of web designing, CSS, Java script, JQuery and familiarized with designing web pages.

COURSE CONTENT:

HTML5

Introduction, New Elements, Canvas, SVG, Drag/Drop, Geolocation, Video, Audio, Input Types, Form Elements, Attributes, Semantic, Web Storage, App Cache, Web Workers, SSE.

Cascading Style Sheets

Introduction, Syntax, Id & Class, Backgrounds, Text, Fonts, Links, Lists, Tables, Box Model, Border, Outline, Margin, Padding, Grouping/Nesting, Dimension, Display, Positioning, Floating, Align, Pseudo-class, Pseudo-element, Navigation Bar.

Radial Gradients of Cascading Style Sheets

Image Gallery, Image Opacity, Image Sprites, Media Types, Animations, Attribute Selectors, CSS3 Introduction, Gradients, Text Effects, Fonts, 2D Transforms, 3D Transforms, Transitions, Animations, Multiple Columns.

JavaScript

Introduction, Comment, Variable, Global Variable, Data Types, Operators, If Statement, Switch, Loop: for and while, Function, Objects, Array, Browser Object Model, Validation.

JQuery

Introduction, Selectors, Events, CSS Classes, Dimensions.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Create and validate HTML/XHTML documents

CO2: Use Cascading Style Sheets as a presentation technologies.

CO3: Understand the radial gradients of CSS.

CO4: Design and implement a simple web pages using JavaScript and JQuery. CO5: Construct a website to include Client-side programming with JavaScript.

REFERENCES :

1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How to Program 5th Edition, Pearson Education 2012.
2. DJ Editorial Services, "HTML5 Black Book", 2nd Edition, Dream tech Press 2016.
3. Thomas A.Powell, HTML & CSS: The Complete Reference, 5th Edition, Tata McGraw-Hill 2010.
4. Thomas A.Powell and Fritz Schneider, JavaScript: The Complete Reference, 3rd Edition, Tata McGraw-Hill, 2013.
5. Thomas A.Powell, Web Design: The Complete Reference, 2nd Edition, Tata McGraw Hill, 2003.

20ITE06	INTRODUCTION TO DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the student to learn basic and advanced concepts related to linear data structures such as lists, stack, queue and non-linear data structures like trees and graphs. It also provides an outline of various sorting, searching and storage techniques.

COURSE CONTENT:

Preliminaries of Data Structures

Basic Terminology- Algorithms: Complexity, Time-Space tradeoff – Algorithmic Notations – Complexity of Algorithms

Arrays and Linked Lists

Linear Arrays – Traversing Linear Arrays – Inserting and Deleting – Linked Lists - Traversal - Search- Insertion, Deletion – Two-way Lists

Stacks, Queues and Recursion

Stacks: Array Representation, Linked Representation – Arithmetic Expressions – Applications: Recursion, Tower of Hanoi – Queues – Linked Representation of Queues – Priority Queues

Trees and Graphs

Tree Terminology - Binary Trees: Representation – Binary Search Trees: Search, Insertion, Deletion – AVL Search Trees: Insertion, Deletion – Heap – Heapsort – Graph Terminology – Graph Representations: Adjacency Matrix, Path Matrix –Shortest Paths (Dijkstra's Algorithm)- Topological Sort – Minimum Spanning Trees (Prim's Algorithm and Kruskal's Algorithm)

Sorting and Searching

Sorting – Insertion Sort – Selection Sort – Radix Sort – Searching and Data Modification - Hashing

COURSE OUTCOMES:

CO1: Apply appropriate data structures and abstract data types (ADT) such as lists, stacks, queues, trees and graphs in problem solving.

CO2: Analyze the performance of different implementations of data structures. CO3: Determine appropriate ADTs and data structures for various sorting and searching algorithms.

CO4: Determine time and space requirements of common sorting and searching algorithms.

CO5: Describe a simple hash function

REFERENCES :

1. Seymour Lipschutz, "Data Structures with C", McGraw Hill, 1st Edition, 2017.
2. John Hubbard, "Data Structures with C++", McGraw Hill, 1st Edition, 2017.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2nd Edition, 2014.
4. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, "Data Structures using C and C++", Pearson, 2nd Edition, 2015.
5. Venkatesan R and Lovelyn Rose S, "Data Structures", Wiley, 2nd Edition, 2019.

20ITE07	PRINCIPLES OF SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

The course will enable the students with the understanding of software engineering processes such as requirement modeling, design, testing etc. and experiential learning opportunities to apply that knowledge to solve real-world problems.

COURSE CONTENT:

Software Process and Agile Development

Introduction to Software Engineering – Process Model: Perspective process models Specialized process models- The unified process - Personal and Team Process Models Agile Process- Other Agile Process Models.

Requirements Modeling

Functional and non-functional requirements – User Requirements – System requirements - Interface specification - The software requirements document - Requirements engineering processes

Design Concepts

Architectural design: Architectural design decisions - System organization - Modular decomposition styles - Control styles - Reference architectures.

Testing

Software Testing Fundamentals - System testing - Component testing - Test case design - Test automation.

Project management

Management activities - Project planning - Project scheduling - Risk management.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the various software process models.

CO2: Apply the requirement specifications and appropriate software design methodology for a given scenario.

CO3: Understand the various architectural styles of software.

CO4: Compare and contrast various testing measures.

CO5: Acquire the knowledge of managing, modern and future software projects.

REFERENCES:

1. Ian Sommerville, "Software Engineering", Pearson Education Asia, 10th Edition, 2017.
2. Roger S Pressman, Bruce R Maxim, "Software Engineering - A Practitioner's Approach", McGraw-Hill Education, 8th Edition, 2019.
3. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning, 4th Edition, 2014
4. Pankaj Jalote, "Software Engineering: A Precise Approach", Wiley India, 2010.
5. Shari Lawrence Pfleeger, "Software Engineering Theory and Practice", Pearson Education, 4th Edition, New Delhi, 2009.

OPEN ELECTIVES

(Offered by Mechanical Engineering Department to other B.E. Programmes)

20MEE01	AUTOMOTIVE FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To provide knowledge on IC Engines, braking, transmission, suspension, starting systems along with insights into new combustion techniques used for various fuels and alternative sources.

COURSE CONTENT:

Vehicle Structure, Engine

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics, IC engines –components function and materials.

Engine Auxiliary Systems

Electronically controlled gasoline injection system for SI engines and diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system).

Transmission Systems

Clutch: Types diaphragm clutch, single and multi-plate clutch, centrifugal clutch and construction, Gear box: Types - gear selector and shifting mechanism, transfer box, propeller shaft, slip joints, universal joints, Differential and rear axle.

Brakes and Suspension Systems

Braking system: Types of brakes, Mechanical, and Air brakes, Disc & Drum brakes, Engine brakes, anti-lock braking system (ABS).Suspension system: Types of Suspension Systems-front and rear suspension.

Alternative Energy Sources and Emission Control

Use of Natural Gas, Liquefied Petroleum Gas, and Hydrogen in Automobiles. Electric and Hybrid Vehicles, Fuel Cell. Engine emission, Engine emission control system, Emission norms (Euro and BS).

COURSE OUTCOMES:

At the end of the course the students will have the ability to

CO1: Identify the fundamental components of automobile structures, engine auxiliary systems, along with brakes and suspension system

CO2: Classify the clutches, gear boxes, braking and suspension systems based on different types of vehicles.

CO3: Examine the various injection systems, ignition systems and gear shifting mechanism along with alternative energy sources and engine emission characteristics.

REFERENCES:

1. Kirpal Singh, "Automobile Engineering", Standard Publishers, Vol-I & II. Thirteenth Edition. New Delhi, 2014.
2. R. K. Rajput, "A Text book of Automobile Engineering", Lakshmi publication, Second Edition. 2014.
3. Heniz Heisler, "Vehicle and Engine Technology, SAE, Second Edition. 2009.
4. Heniz Heisler, "Vehicle and Engine Technology, SAE, Second Edition. 2009.
5. Gupta R B, "Automobile Engineering", Satya Prakashan, 2015.
6. Heniz Heisler, "Vehicle and Engine Technology, SAE, Second Edition. 2009.

20MEE02	COMPUTER AIDED DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To provide an overview of how computers are being used in engineering component designs and make the students understand different CAD standards used in Industries

COURSE CONTENT:

Fundamentals of Computer Graphics

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation

Geometric Modeling

Geometry and topology -representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches. Solid modeling techniques- CSG

Assembly of Parts

Assembly modelling – interferences of positions and orientation – tolerance analysis- mass property calculations – mechanism simulation and interference checking.

CAD Standards

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc., Communication standards.

COURSE OUTCOMES:

At the end of the course the students will have the ability to

CO1: Identify the fundamental components of computer graphics such as product cycle, CAD system and architecture, computer graphics, homogeneous coordinates, geometry, topology along with assembly of parts and CAD standards

CO2: Classify the types of Coordinate systems, representation of different curves, surface modeling techniques and the various standards used in computer graphics such as GKS, open, IGES, STEP, and CALS.

CO3: Examine the assembly modeling with interferences of position and orientation, tolerance analysis and communication standards

REFERENCES:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007
2. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
3. William M Neumann and Robert F.Sproul, “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
4. Donald Hearn and M. Pauline Baker , “Computer Graphics”, Prentice Hall, Inc, 1992.
5. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.

20MEE03	INTRODUCTION TO POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To providing an overview of power plants and detailing the role of Engineers in their operation and maintenance of renewable power sources,

COURSE CONTENT:

Layout of Power Plants

Layout of Steam, Hydel, Diesel, Nuclear and Gas Turbine Power Plants - Combined Power Cycles – Comparison and Selection

Nuclear and Hydro Power Plants

Nuclear Energy – Fission, Fusion Reaction, Types of Reactors, Waste Disposal and safety. Hydroelectric power plants – runoff storage and pumped storage type.

Diesel and Gas Power Plants

Types of Diesel Plants, Components, Selection of Engine Type, Applications, environmental hazards- Gas Turbine Power Plant – Fuels - Gas Turbine Material – Regeneration and Intercooling.

Solar, Tidal, Wind Power Plants and Economic Issues Of Power Plants

Tidal - Solar thermal central receiver system – wind power plants -Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs.

COURSE OUTCOMES:

At the end of the course the students will have the ability to

CO1: Identify the fundamental components of power plant layouts along with the selection procedure.

CO2: Classify the types of power plant layouts, reactors based on the type of fuel energy utilized.

CO3: Examine the various components and systems of different power plants such as nuclear, hydro, diesel, gas. Solar, tidal, wind and to determine the economical issues associated with them.

REFERENCES:

1. EI- Wakil M. M, “Power Plant Technology”, McGraw-Hill, Second Edition, 2014.
2. Arora S. C and Domkundwar S, “A course in Power Plant Engineering”, Dhanpatrai, Third Edition, 2012.
3. Nag P.K, “Power Plant Engineering”, Tata McGraw-Hill, 2014.
4. G. D. Rai, “Introduction to Power Plant Technology”, Khanna Publishers, Third Edition, 2014.
5. T. Morse Frederick, “Power Plant Engi neering”, Prentice Hall of India, Third Edition, 2014.
6. Culp A. W., “Principles of Energy Conversion”, McGraw Hill, Second Edition, 2014.

20MEE04	INTRODUCTION TO ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To impart knowledge about automation, various sensors and their applications in robots. Along with Robot Programming methods & Languages used by robots.

COURSE CONTENT:

Introduction

Automation and robotics –History of robotics - Definition of a Robot - Basic Concepts - Robot configurations - Types of Robot drives - Basic robot motions - Point to point control - Continuous path control.

Components And Operations

Basic control system concepts - control system analysis - robot actuation and fed back, Manipulators Coordinate transformation - Brief Robot dynamics. Types of Robot and effectors - Grippers - Tools as end effectors - Robot/End - effort interface.

Sensing and Machine Vision

Range sensing - Proximity sensing - Touch sensing - Force and Torque sensing. Introduction to Machine vision - Sensing and digitizing - Image processing and analysis.

Robot Programming

Methods - languages - Capabilities and limitation - Artificial intelligence - Knowledge representation - Search techniques - AI and Robotics.

Industrial Applications

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading - CIM - Hostile and remote environments

COURSE OUTCOMES:

At the end of the course the students will have the ability to

CO1: Identify the basic control system concepts, manipulator coordinate transformation, robot dynamics, range sensing, Artificial intelligence and industrial applications of robot such as in Welding, Assembly, Material handling, Loading and unloading,

CO2: Classify the types of robots, end effectors, grippers, sensing techniques and robot programming methods,

CO3: Examine the languages, Capabilities, limitations and Search techniques of robots

REFERENCES:

1. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2010
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012
3. Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2011.
4. K.S. Fu., R.C.Gonalez, C.S.G.Lee, “Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 2000.
5. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.

20MEE05	3D PRINTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To understand the various RPT processes adopted to produce parts and to impart knowledge on three-dimensional printing, reverse engineering, current technologies and their influence in manufacturing.

COURSE CONTENT:

Fundamentals of RPT

Development of RP systems, Rapid Tooling, Rapid Manufacturing- Principle –Fundamental – File format – Other translators – medical applications of RP- Materials for Rapid Prototyping Systems

Liquid Based Rapid Prototyping Systems

Liquid based system – Stereolitho graphy Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses.

Solid Based Rapid Prototyping Systems

Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing

Powder Based Rapid Prototyping Systems

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses.

Reverse Engineering And New Technologies

Reverse Engineering - Introduction, measuring device- contact type and non-contact type, CAD model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, and other applications.

COURSE OUTCOMES:

At the end of the course the students will have the ability to

CO1: Identify the development of RP systems such as liquid, solid and powder based systems, Rapid Tooling, Rapid Manufacturing principle and Fundamentals, File format, translators and medical applications of RP, Materials for Rapid Prototyping Systems along with the concept of reverse engineering.

CO2: Classify the advantages, disadvantages and limitations of liquid, solid and powder based rapid prototyping systems along with the types of measuring devices utilized in reverse engineering.

CO3: Examine the Stereo lithography Apparatus (SLA), Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing based on principles, process and products,

CO4: Analyze the concept of reverse engineering, medical data processing and software for making medical models, medical materials, and other applications.

REFERENCES:

1. Douglas Bryden, "CAD and Rapid Prototyping for Product Design", Laurence King, 2014.
2. Kalani Kirk Hausman, Richard Horne, "3D Printing For Dummies", Wiley Publications, 2014.
3. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim "Rapid Prototyping: Principles and Applications" World Scientific Publication Pvt., Ltd, 2011.
4. Chua C. K, Leong K. F and Lim C. S, "Rapid Prototyping: Principles and Applications", World Scientific, second edition, 2010.
5. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototyping", Wiley, 2006.

OPEN ELECTIVES

(Offered by ECE Department to other B.E. Programmes)

20ECE01	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamentals of electrical and electronic instruments, measurement techniques, storage and display devices.

COURSE CONTENT:

Introduction

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement — Standards and calibration

Electrical and Electronic Instruments

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss.

Comparative Methods of Measurements

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

Storage and display Devices

Magnetic disk and tape –digital plotters and printers, CRT display, digital CRO, OLED,LED display systems, LCD –USB Data Loggers.

Transducers and Data Acquisition Systems

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Find electrical parameters using appropriate Electronics Instruments.

CO2: Interpret the characteristics and operation of Electrical and Electronic Instruments.

CO3: Apply storage and display devices.

CO4: Select appropriate sensors in various applications.

REFERENCES:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.
3. J Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
4. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
5. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.

20ECE02	MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the primary concept of microcontrollers, hardware usage for programming intelligence and get familiarized with the architecture, instruction set and applications of microcontroller.

COURSE CONTENT:

8051 Microcontroller

Architecture of 8051 – Register set - I/O Pins, Ports and Circuits - Instruction set - Addressing modes - Assembly language programs for arithmetic and Logical operations.

Interfacing 8051 Microcontroller

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - Stepper Motor Interfacing –ADC – DAC.

Application of 8051 Microcontroller

Temperature Controller using ADC – Square and Triangular waveform generation using DAC – Water level controller – Traffic Light Controller.

PIC Microcontroller

CPU Architecture – Register – I/O pins, Ports -Instruction set – addressing modes - Interrupts

Interfacing PIC Microcontroller

PIC: Timers- I2C Interfacing –UART- A/D Converter –Pulse Width Modulation

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Interpret the architecture of 8051 and PIC microcontrollers.

CO2: Develop Assembly Language Programs (ALP) for arithmetic and Logical operations using microcontrollers.

CO3: Build 8051 microcontroller-based systems using peripheral interfaces.

CO4: Build PIC microcontroller-based systems using peripheral interfaces.

REFERENCES:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson Education, 2011
2. Subrata Ghoshal, "8051 Microcontrollers: Internals, Instructions, Programming &Interfacing", Second Edition, Pearson education, 2014.
3. John. B. Peatman, "Design with PIC Microcontroller", Prentice Hall, 2011.
4. Gene .H.Miller, "Micro Computer Engineering", Pearson Education, 2013.
5. Subrata Ghoshal, "8051 Microcontrollers: Internals, Instructions, Programming &Interfacing", Second Edition, Pearson education, 2014.

20ECE03	INTRODUCTION TO EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the architecture of embedded systems, design and analysis of embedded computing, basic concepts of real time operating system, programming concepts for embedded systems, system design techniques of embedded hardware and its applications.

COURSE CONTENT:

Architecture of Embedded Systems

Categories of Embedded Systems – Specifications of Embedded systems – Recent trends in Embedded Systems – Detailed Hardware and Software Design – ARM Processor – CPU: programming input and output - supervisor mode, exceptions and traps – Co-processors – Memory system mechanisms – CPU performance – CPU power consumption.

Embedded Computing Platform Design

The CPU Bus-Memory devices and systems – Designing with computing platforms – Host and target machines – consumer electronics architecture – platform-level performance analysis - Components for embedded programs – Models of programs – Assembly, linking and loading – compilation techniques – Program level performance analysis

Processes and Operating Systems

Introduction – Multiple tasks and multiple processes – Multi rate systems – Preemptive real-time operating systems – Priority based scheduling – Inter process communication mechanisms –Semaphores and Shared Data – Message Queues – Mailboxes and Pipes – Interrupt Routines in RTOS Environment – Evaluating operating system performance – power optimization strategies for processes.

Hardware/Software Integration & Programming

Cross-Compilers – Cross-Assemblers – Linker/Locator – Debugger – Emulator – Simulators – Introduction to Integrated Development Environment (IDE) – Getting Embedded Software into Target System: In-Circuit Emulators –Serial Port Programming and Interrupts Programming.

Embedded System Applications

Applications of Embedded systems – Case study of Embedded systems like automatic chocolate vending machine, Adaptive Cruise Control Systems in a Car, Digital camera, Smart card and ATM.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the architecture of embedded systems.

CO2: Understand the concepts of multiple processes and operating systems.

CO3: Choose appropriate tools for developing real time embedded systems.

CO4: Apply suitable hardware and software architectures to implement embedded system applications.

REFERENCES:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jonathan W. Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.
3. Raj Kamal, “Embedded Systems Architecture Programming and Design”, Pearson, 2011.
4. K.V.K.K.Prasad “Embedded /Real-Time Systems: Concepts, Design and Programming” Dream tech, Wiley 2012.

5. Daniel 5.W Lewis, “Fundamentals of Embedded Software” Pearson Education, 2013.

20ECE04	NANO ELECTRONICS AND SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the overview of nano electronics, basic components of electronic systems, memory devices, sensors and actuators.

COURSE CONTENT:

Overview of Nano-Electronics

Nano-scale electronics; Foundation of nano-electronics – low dimension transport, quantum confinement, Coulomb blockade and quantum dot; Ballistic transport and Quantum interferences; Landauer formula, quantization of conductance, example of Quantum point contact.

Two-Terminal Junction Transistors

Basic CMOS process flow; MOS scaling theory; Issues in scaling MOS transistors; Requirements for non-classical MOS transistor; PMOS versus NMOS; Design and construction of MOS capacitor; Integration issues of high-k MOS – interface states, bulk charge, band offset, stability, reliability; MOS transistor and capacitor characteristics.

Gate Transistors

Metal gate transistors – motivation, basics and requirements; quantum transport in nano MOSFET; Ultrathin body silicon on insulator (SOI) – double gate transistors; Vertical transistors – FinFET and surround gate FET; compound semiconductor MOSFET – Hetero-structures MOSFET.

Characteristics of Sensors and Actuators

Basics: types and working principles of sensors and actuators; Characteristic features: Range, Resolution, Sensitivity, Error, Repeatability, Linearity and Accuracy, Impedance, Nonlinearities, Static and Coulomb Friction, Eccentricity, Backlash, Saturation, Dead-band, System Response, First Order System Response, Under-damped Second Order System Response, Frequency Response.

Memory Devices and Sensors

Nano ferroelectrics – Ferroelectric random-access memory –Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Understand the concepts of Nano electronics

CO2: Interpret the characteristics and operation of Gate transistors.

CO3: Interpret the characteristics of sensors and actuators.

CO4: Understand the operation of memory devices and sensors.

REFERENCES:

1. W. Ranier, 'Nano Electronics and Information Technology', Wiley, 2003.
2. K.E. Drexler, 'Nano systems', Wiley, 1992.
3. M.C. Petty, 'Introduction to Molecular Electronics', 1995.
4. Handbook of Nanoscience, Engineering and Technology", Kluwer publishers, 2002.
5. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications", Imperial College Press, 2004.

20ECE05	PRINCIPLES OF VLSI SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the principles of MOS transistors, realization of combinational and sequential logic circuits using MOS transistors, arithmetic building blocks and implementation strategies using FPGA.

COURSE CONTENT:

MOS Transistor Principle

NMOS and PMOS transistor operations, MOS DC Equations, Electrical properties of CMOS circuits and device modeling, scaling principles CMOS inverter, Second Order Effects, Stick diagram.

Combinational Logic Circuits

MOSFETs as switches, Basic Logic Gates in CMOS, Examples of Combinational Logic Design, RC Delay Model, Linear Delay Model, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design.

Sequential Logic Circuits

Static and Dynamic Latches and Registers, Timing issues, Memory architecture and memory control circuits.

Arithmetic Building Blocks

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, Multipliers, speed and area tradeoff

Implementation Strategies

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Xilinx FPGA.

COURSE OUTCOMES:

At the end of the course student should have the ability to,

CO1: Interpret the characteristics and operation of MOS transistors.

CO2: Interpret the operation of VLSI architecture using FPGA.

CO3: Build CMOS based arithmetic and logic circuits.

CO4: Build CMOS based sequential circuits.

REFERENCES:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2013.
2. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 2001.
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2009.
4. Weste and Harris: CMOS VLSI DESIGN: A Circuits and Systems Perspective (Fourth edition) Pearson Education, 2010.
5. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 2009.

20ECE06	Measurement, Instrumentation and Sensors	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the fundamentals of Electronic instruments, measurement techniques, display devices and Sensors.

COURSE CONTENT:

Measurements Fundamentals

Basics of Measurements – Measurements and its elements – Static and dynamic characteristics –Errors–Types of errors - Statistics of errors - Standards & Calibration.

Instruments and display Devices

Digital voltmeter- Digital Multi-meter–Digital Frequency meter– Single and three phase energy meters - LCD, LED, and OLED display systems - Grounding techniques.

Sensors and Transducers

Smart sensors – Temperature- Ultrasonic - MEMS & Nano Sensors - Motion Sensors - LASER sensors. Transducers – Hall Effect &Piezoelectric transducers – Thermocouples - Data Acquisition System.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to find electrical parameters using appropriate Electronics Instruments.

CO2: Ability to interpret the characteristics and operation of Electronic Instruments.

CO3: Ability to apply grounding and display devices.

CO4: Ability to select appropriate sensors in various applications.

REFERENCES:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi,2003.
3. J Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, SpecialIndian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
4. PrithwirajPurkait,'Electrical&Electronic Measurements and Instrumentation', Tata McGraw Hill, 2013.
5. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

20ECE07	PRINCIPLES OF EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

This course will enable the students to learn the building blocks of embedded system, various embedded development strategies, bus communication in processors and input/output interfacing. This course also focuses on the basics of real time operating system and various case studies.

COURSE CONTENT:

EMBEDDED SYSTEMS

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory

management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

EMBEDDED NETWORKING

I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C).

EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

EMBEDDED SYSTEM APPLICATION DEVELOPMENT

Introduction to RTOS –Issues in embedded system Design - Case Study: Washing Machine-Automotive Application- Smart card System Application.

COURSE OUTCOMES:

At the end of the course, the students will have the

CO1: Ability to understand the building blocks of Embedded Systems

CO2: Ability to describe the concepts of networking for Embedded systems

CO3: Ability to understand development environment for Embedded systems

CO4: Ability to apply hardware architecture to implement embedded systems applications.

REFERENCES:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013.
2. Peckol, "Embedded system Design", John Wiley & Sons,2010
3. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
4. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
5. Elicia White," Making Embedded Systems", O' Reilly Series, SPD,2011.
6. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
7. Han-Way Huang," Embedded system Design Using C8051", Cengage Learning,2009.
8. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.