NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi
for
B.E – Electronics and Communication Engineering [R17]
[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year 2017-2018 onwards)

APRIL 2023

NANDHA ENGINEERING COLLEGE (AUTONOMOUS), ERODE – 638 052

REGULATIONS – 2017 **CHOICE BASED CREDIT SYSTEM**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM: I – VIII SEMESTERS **SYLLABUS: 1 to 8 SEMESTERS**

SEMESTER: I									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17EYA01	Professional English- I	HS	-	4	2	0	2	3
2.	17MYB01	Calculus and Solid Geometry	BS	-	5	3	2	0	4
3.	17PYB01	Physics for Engineers	BS	-	3	3	0	0	3
4.	17CYB02	Applied Electrochemistry	BS	-	3	3	0	0	3
5.	17CSC02	Python Programming	ES	-	3	3	0	0	3
6.	17ECC01	Electronic Devices	ES	-	3	3	0	0	3
PRACTICAL									
7.	17CSP02	Python Programming Laboratory	ES	-	4	0	0	4	2
8.	17GYP02	Engineering Practices Laboratory	ES	-	4	0	0	4	2
9.	17GEP01	Personal Values	HS	-	2	0	0	2	0
				TOTAL	**31**	**17**	**2**	**12**	**23**

SEMESTER: II									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17EYA02	Professional English – II	HS	17EYA01	4	2	0	2	3
2.	17MYB02	Complex Analysis and Laplace Transforms	BS	17MYB01	5	3	2	0	4
3.	17PYB05	Physics of Solids	BS	17PYB01	3	3	0	0	3
4.	17CYB03	Environmental Science	BS	-	3	3	0	0	3
5.	17MEC01	Engineering Graphics	ES	-	4	2	2	0	3
6.	17ECC03	Circuit Theory	ES	-	3	3	0	0	3
PRACTICAL									
7.	17GYP01	Physics and Chemistry Laboratory	BS	-	4	0	0	4	2
8.	17ECP01	Circuits and Devices Laboratory	ES	17ECC01	4	0	0	4	2
9.	17GEP02	Inter Personal Values	HS	17GEP01	2	0	0	2	0
				TOTAL	**32**	**16**	**4**	**12**	**23**

SEMESTER: III									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17MYB05	Transforms and Partial Differential Equations	BS	17MYB02	4	2	2	0	3
2.	17ITC03	Data Structures and Algorithms	ES	-	4	2	0	2	3
3.	17ECC05	Electrical Machines and instruments	ES	-	3	3	0	0	3
4.	17ECC06	Digital Logic Design	PC	17ECC01	3	3	0	0	3
5.	17ECC07	Signals and Systems	PC	17MYB02	4	2	2	0	3
6.	17ECC08	Analog Electronics	PC	17ECC01	3	3	0	0	3
PRACTICAL									
7.	17ECP03	Digital Logic Design Laboratory	PC	17ECP01	4	0	0	4	2
8.	17ECP04	Analog Electronics Laboratory	PC	17ECP01	4	0	0	4	2
9.	17GED02	Soft Skills-Reading and Writing	EEC	-	2	0	0	2	0
				TOTAL	**31**	**15**	**4**	**12**	**22**

SEMESTER: IV									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17MYB09	Probability and Random Processes	BS	17MYB02	4	2	2	0	3
2.	17ITC08	Fundamentals of Java Programming	ES	-	4	2	0	2	3
3.	17ECC10	Electromagnetic Fields	ES	17PYB01	4	2	2	0	3
4.	17ECC11	Analog Circuit Design	PC	17ECC01	3	3	0	0	3
5.	17ECC12	Digital Signal Processing	PC	-	4	2	2	0	3
6.	E1	Elective I (PSE)	PSE	-	3	3	0	0	3
PRACTICAL									
7.	17ECP06	Analog Circuit Design Laboratory	PC	17ECP01	4	0	0	4	2
8.	17ECP07	Digital Signal Processing Laboratory	PC	17ECC07	4	0	0	4	2
9.	17GED01	Soft Skills-Listening and Speaking	EEC	-	2	0	0	2	0
10.	17GED03	Personality and Character Development	EEC	-	1	0	0	1	0
				TOTAL	**33**	**14**	**6**	**13**	**22**

SEMESTER: V									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17GEA02	Principles of Management	HS	-	3	3	0	0	3
2.	17ECC13	Microprocessors and Microcontrollers Interfacing	PC	17ECC06	3	3	0	0	3
3.	17ECC14	Data Communication and Networks	PC	17ECC06	3	3	0	0	3
4.	17ECC15	Transmission Lines and Waveguides	PC	17ECC10	4	2	2	0	3
5.	E2	Elective II (PSE)	PSE	-	3	3	0	0	3
6.	E3	Elective III (PSE)	PSE	-	3	3	0	0	3
PRACTICAL									
7.	17ECP08	Microprocessors and Microcontrollers Interfacing Laboratory	PC	17ECP03	4	0	0	4	2
8.	17ECP09	Data Communication and Networks Laboratory	PC	17ECP03	4	0	0	4	2
9.	17GED08	Essence of Indian Traditional Knowledge	EEC	-	2	0	0	2	0
				TOTAL	**29**	**17**	**2**	**10**	**22**

SEMESTER: VI									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17ECC16	Analog and Digital Communication	PC	17ECC06	3	3	0	0	3
2.	17ECC17	VLSI Design	PC	17ECC13	3	3	0	0	3
3.	E4	Elective IV (PSE)	PSE	-	3	3	0	0	3
4.	E5	Elective V (PSE)	PSE	-	3	3	0	0	3
5.	E6	Elective VI (PSE)	PSE	-	3	3	0	0	3
6.	E 7	Elective VII	PSE/OE	-	3	3	0	0	3
PRACTICAL									
7.	17ECP10	Analog and Digital Communication Laboratory	PC	17ECP03	4	0	0	4	2
8.	17ECP11	VLSI Design Laboratory	PC	17ECP08	4	0	0	4	2
9.	17GED06	Comprehension	EEC	ALL CORE SUBJECT	2	0	0	2	0
10.	17GED07	Constitution of India	EEC	-	2	0	0	2	0
				TOTAL	**31**	**17**	**0**	**14**	**22**

SEMESTER: VII									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	17ECC19	Microwave Engineering	PC	17ECC18	3	3	0	0	3
2.	17ECC20	Optical Communication	PC	17ECC16	3	3	0	0	3
3.	17ECC21	Embedded and Real Time Systems	PC	17ECC13	3	3	0	0	3
4.	17ECC18	Antenna and Wave Propagation	PC	17ECC15	4	2	0	2	3
5.	E 8	Elective VIII	PSE/OE	-	3	3	0	0	3
PRACTICAL									
6.	17ECP12	Microwave and Optical Laboratory	PC	17ECP10	4	0	0	4	2
7.	17ECP13	Embedded Systems Laboratory	PC	17ECP08	4	0	0	4	2
8.	17ECD01	Project work-I	EEC	-	8	0	0	8	4
				TOTAL	**31**	**15**	**0**	**16**	**23**

SEMESTER: VIII									
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PREREQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	E 9	Elective IX (OE)	OE	-	3	3	0	0	3
PRACTICAL									
2.	17ECD02	Project work-II	EEC	17ECD01	16	0	0	16	8
				TOTAL	**19**	**3**	**0**	**16**	**11**

TOTAL NO. OF CREDITS: 168

(C) Elective Courses										
(a)Program Specific Electives(PSE)			AICTE Credit Distribution Norm:18							
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1.	17ECX01	Medical Electronics	PSE	-	3	3	0	0	3	IV
2.	17ECX02	Nano Electronics	PSE	-	3	3	0	0	3	IV
3.	17ECX03	Radar and Navigational Aids	PSE	-	3	3	0	0	3	V
4.	17ECX04	Sensor and its Applications	PSE	-	3	3	0	0	3	V
5.	17ECX05	MEMS and its Application	PSE	-	3	3	0	0	3	VI
6.	17ECX06	Computer Hardware Interfacing	PSE	-	3	3	0	0	3	VI
7.	17ECX07	Control Systems Engineering	PSE	-	3	3	0	0	3	VI
8.	17ECX08	Digital Image Processing	PSE	-	3	3	0	0	3	VI
9.	17ECX09	Wireless Communication	PSE	-	3	3	0	0	3	VII
10.	17ECX10	High Speed Networks	PSE	-	3	3	0	0	3	VII
11.	17ECX11	Modern Microprocessors and Microcontrollers	PSE	-	3	3	0	0	3	VII
12.	17ECX12	Protocols and Architectures for Wireless Sensor Networks	PSE	-	3	3	0	0	3	VII
13.	17ECX13	Telecommunication Switching and Networks	PSE	-	3	3	0	0	3	VII
14.	17ECX14	Multimedia Compression Techniques	PSE	-	3	3	0	0	3	VIII
15.	17ECX15	Satellite Communication	PSE	-	3	3	0	0	3	VIII
16.	17ECX16	Internet of Things and its applications	PSE	-	3	3	0	0	3	VII
17.	17ECX17	Speech Processing	PSE	-	3	3	0	0	3	VII
18.	17ECX18	Opto Electronic Devices	PSE	-	3	3	0	0	3	VII
19.	17ECX19	Cryptography and Network Security	PSE	-	3	3	0	0	3	VI
20.	17ECX20	Statistical Theory of Communication	PSE	-	3	3	0	0	3	VII
21.	17ECX21	Cognitive Radio	PSE	-	3	3	0	0	3	VI
22.	17CSX01	Data Science	PSE	-	3	3	0	0	3	VIII
23.	17CSX26	HADOOP Distributed Environment	PSE	-	3	3	0	0	3	VIII
24.	17CSX31	Problem Solving And Programming	PSE	-	3	3	0	0	3	III
25.	17ITC12	Database Systems Concepts	PSE	-	3	3	0	0	3	VIII
26.	17ITX26	Problem Solving And Algorithmic Skills	PSE	-	3	3	0	0	3	VI
27.	17GEA03	Total Quality Management	PSE	-	3	3	0	0	3	VIII
28.	17GEA04	Professional Ethics and Human Values	PSE	-	3	3	0	0	3	VI
29.	17MYB12	Basic Statistics and Numerical Analysis	PSE	-	3	3	0	0	3	VI
30.	17ITX29	IT operations	PSE	-	3	3	0	0	3	VII

31.	17ITX30	IT operations Advanced	PSE	-	3	3	0	0	3	VII
32.	17ECX22	Professional Readiness for Innovation, Employability and Entrepreneurship	PSE	-	3	3	0	0	3	VII

(b)Open Electives			**AICTE Credit Distribution Norm:18**							
1.	17AGZ01	Baking and Confectionery Technology	OE	-	3	3	0	0	3	VII
2.	17AGZ02	Food safety and quality control system	OE	-	3	3	0	0	3	VII
3.	17AGZ03	Farm Mechanization	OE	-	3	3	0	0	3	VIII
4.	17AGZ04	Processing of Fruits and Vegetables	OE	-	3	3	0	0	3	VIII
5.	17CHZ01	Waste Water Treatment	OE	-	3	3	0	0	3	VII
6.	17CHZ02	Piping Engineering	OE	-	3	3	0	0	3	VII
7.	17CHZ03	Process Automation	OE	-	3	3	0	0	3	VII
8.	17CHZ04	Process Instrumentation	OE	-	3	3	0	0	3	VII
9.	17CEZ01	Energy conservation in buildings	OE	-	3	3	0	0	3	VII
10.	17CEZ02	Air Pollution Management	OE	-	3	3	0	0	3	VIII
11.	17CEZ03	Building Services	OE	-	3	3	0	0	3	VIII
12.	17CEZ04	Road Safety Management	OE	-	3	3	0	0	3	VII
13	17CEZ05	Waste Management	OE	-	3	3	0	0	3	VII/VIII
14	17CSZ01	Design Thinking	OE	-	3	3	0	0	3	VII
15	17CSZ02	Digital Marketing	OE	-	3	3	0	0	3	VII
16	17CSZ03	Software Engineering	OE	-	3	3	0	0	3	VIII
17	17CSZ04	Unified Functional Testing	OE	-	3	3	0	0	3	VIII
18	17CSZ05	C Programming	OE	-	3	3	0	0	3	VI
19	17CSZ06	Data Structures	OE	-	3	3	0	0	3	VI
20	17CSZ07	Web Services using Java	OE	-	3	3	0	0	3	VI
21	17ECZ01	Modern wireless communication system	OE	-	3	3	0	0	3	VII
22	17ECZ02	Consumer Electronics	OE	-	3	3	0	0	3	VII
23	17ECZ03	Automotive Electronics	OE	-	3	3	0	0	3	VIII
24	17ECZ04	Electronic Testing	OE	-	3	3	0	0	3	VIII
25	17EEZ01	Renewable Energy Technology	OE	-	3	3	0	0	3	VII
26	17EEZ02	Smart Grid	OE	-	3	3	0	0	3	VII
27	17EEZ03	Energy Auditing, Conservation and Management	OE	-	3	3	0	0	3	VIII

58	17EYX01	Effective Communication	OE	-	3	3	0	0	3	VII
59	17GYZ01	Biology for Engineers	OE	-	3	3	0	0	3	VII
60	17BMZ01	Health care technology	OE	-	3	3	0	0	3	VII
61	17BMZ02	Telemedicine	OE	-	3	3	0	0	3	VII
62	17BMZ03	Epidemiology and Pandemic Management	OE	-	3	3	0	0	3	VII
63	17BMZ04	Medical Ethics	OE	-	3	3	0	0	3	VII
64	17EYZ05	Work place Communication	OE	-	3	3	0	0	3	VII

(D) Employability Enhancement Courses			AICTE Credit Distribution Norm:15							
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PREREQUISITE	CONTACT PERIODS	L	T	P	C	P.S
1.	17GED03	Personality and Character Development	EEC	-	1	0	0	1	0	VI
2.	17GED06	Comprehension	EEC	ALL CORE SUBJECS	2	0	0	2	0	VII
3.	17ECD01	Project Work-I	EEC	-	8	0	0	8	4	VII
4.	17ECD02	Project Work-II	EEC	17ECD01	16	0	0	16	8	VIII
5.	17GED07	Constitution of India	EEC	-	2	2	0	0	0	VI
6.	17GED08	Essence of Indian traditional knowledge	EEC	-	2	2	0	0	0	V

Bucket for Honor Courses										
(i)	**Robotics and Sensor Technology**									
1.	17ECX23	Sensors and sensor circuit design	PSE	-	3	3	0	0	3	-
2.	17ECX24	Sensors and Actuators	PSE	-	3	3	0	0	3	-
3.	17ECX25	Smart sensors for Health care Application	PSE	-	3	3	0	0	3	-
4.	17ECX26	Principles of Robotics	PSE	-	3	3	0	0	3	-
5.	17ECX27	Robotics and Control- Theory and Practice	PSE	-	3	3	0	0	3	-
6.	17ECX28	Programming for Robotics	PSE	-	3	3	0	0	3	-
7.	17ECX29	AI for robotics	PSE	-	3	3	0	0	3	-
8.	17ECX30	Robotics for Industrial applications	PSE	-	3	3	0	0	3	-
(ii)	**Image and Video Processing**									
1.	17ECX31	Image Signal Processing	PSE	-	3	3	0	0	3	-
2.	17ECX32	Digital Video Signal Processing	PSE	-	3	3	0	0	3	-
3.	17ECX33	Digital Speech Processing	PSE	-	3	3	0	0	3	-
4.	17ECX34	Pattern Recognition	PSE	-	3	3	0	0	3	-
5.	17ECX35	Medical Image Analysis	PSE	-	3	3	0	0	3	-

6.	17ECX36	Image and Video Analytics	PSE	-	3	3	0	0	3	-
7.	17ECX37	Computer Vision	PSE	-	3	3	0	0	3	-
8.	17ECX38	Deep Learning for Visual Computing	PSE	-	3	3	0	0	3	-
Minor Courses										
(i)	**Semi Conductor Technologies**									
1.	17ECM01	Fundamentals of Semiconductor Devices	OE	-	3	3	0	0	3	-
2.	17ECM02	Semiconductor devices and circuits	OE	-	3	3	0	0	3	-
3.	17ECM03	Semiconductor Device Modelling and Simulation	OE	-	3	3	0	0	3	-
4.	17ECM04	Basic Electronics	OE	-	3	3	0	0	3	-
5.	17ECM05	Semiconductor Optoelectronics	OE	-	3	3	0	0	3	-
6.	17ECM06	Micro Electro Mechanical Systems	OE	-	3	3	0	0	3	-
7.	17ECM07	An introduction to Electronic system Packaging	OE	-	3	3	0	0	3	-
8.	17ECM08	System on a chip Design	OE	-	3	3	0	0	3	-

SUMMARY

S. No.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3	3	0	0	3	0	0	0	9
2.	BS	10	12	3	3	0	0	0	0	28
3.	ES	10	8	6	6	0	0	0	0	30
4.	PC	0	0	13	10	13	13	13	0	62
5.	PSE	0	0	0	3	6	9	3	0	21
6.	OE	0	0	0	0	0	0	3	3	6
7.	EEC	0	0	0	0	0	0	4	8	12
CREDITS TOTAL		23	23	22	22	22	22	23	11	168

17ECX22 – PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP				
	L	T	P	C
	1	0	4	3

PREREQUISITE : NIL	QUESTION PATTERN : TYPE -NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To give practice to access the resources, gain knowledge about the technology used and list the ideas for project in the chosen domain.	1.1	The students will be able to access the resources, gain knowledge about the technology used and list the ideas for project in the chosen domain.	a,b,c,d,e,f,g,h,i,j, k,l
2.0	To develop an ability to propose a solution document fit to the problem, prepare Solution Architecture, Data Flow Diagram and Technology Architecture.	2.1	The students will be able propose a solution document fit to the problem, prepare Solution Architecture, Data Flow Diagram and Technology Architecture.	a,b,c,d,e,f,g,h,i,j, k,l
3.0	To prepare milestones and tasks, sprint schedules, coding and Testing.	3.1	The students will be able to prepare milestones and tasks, sprint schedules, coding and Testing.	a,b,c,d,e,f,g,h,i,j, k,l

PHASE I – PREPARATION PHASE	**(3+3)**
Access the resources - Join the mentoring channel - Register on IBM academic Initiative - Create Github account – Setup the System based on pre-requisites.	
PHASE II – IDEATION PHASE	**(3+15)**
Literature Survey – Technology Trainings – Empathy Canvas map Preparation – List the ideas.	
PHASE III – PROJECT DESIGN PHASE - I	**(3+9)**
Proposed solution document preparation – Problem solution fit - Solution Architecture Preparation.	
PHASE IV – PROJECT DESIGN PHASE - II	**(3+9)**
Requirement Analysis - Customer Journey – Data Flow Diagrams – Technology Architecture.	
PHASE V – PROJECT PLANNING PHASE	**(3+3)**
Milestones and Tasks preparation – Sprint Schedules	
PHASE VI – PROJECT DEVELOPMENT PHASE	**(0+21)**
Coding & Solutioning – Acceptance Testing – Performance Testing	
TOTAL (T:15+P:60) = 75 PERIODS	

17ECX23 – SENSORS AND SENSOR CIRCUIT DESIGN				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of the sensors and transducers.	1.1	The students will be able to design sensors and measure various parameters in sensors.	a,b,c
2.0	To learn about the various sensors used for temperature measurement.	2.1	The students will be able to design a suitable temperature sensor according to the needs.	a,b,f
3.0	To understand the design of the various sensors used for pressure and flow measurement.	3.1	The students will be able to design a suitable pressure and flow sensor accordingly.	a,b,c,d
4.0	To learn about the various sensors used for displacement and velocity measurement	4.1	The students will be able to design a suitable displacement and velocity sensor according to requirement.	a,b,c,l
5.0	To understand the concepts of general sensors used for various applications.	5.1	The students will be able to demonstrate knowledge of various sensors for different aplications.	a,b,d,l

UNIT I – INTRODUCTION	**(9)**
Overview of sensors, sensor circuits, applications, Measurement system architecture, Sensor dynamics, overview of Signal Conditioning, Measurement characteristics, Sensors and Transducers, Basic Interfacing circuits	
UNIT II – TEMPERATURE MEASUREMENT	**(9)**
Principle of operation- Bimetallic thermometer, Resistance Temperature Detectors, Thermistors, Thermocouples, IR thermometers, Integrated circuit temperature transducer	
UNIT III - PRESSURE AND FLOW MEASUREMENT	**(9)**
Principle of operation - Liquid manometers, Resistive transducer, Capacitance transducer, Piezoelectric transducer, Venturi flow meters, Electro-Magnetic flow meter - liquid level measurement using float.	
UNIT IV – DISPLACEMENT AND VELOCITY MEASUREMENT	**(9)**
Linear and angular measurement systems – Resistance potentiometer, strain gauge - capacitive transducers and variable inductance transducers, resolvers, LVDT, proximity sensors, ultrasonic and photo-electric sensors - linear scales - Laser Interferometers, tachogenerator - Encoders: absolute and incremental – Piezoelectric	
UNIT V – OTHER SENSORS	**(9)**
Sensors for measurement of vibration, Acoustics, humidity, weight, volume and radiation - Tactile sensors: force, torque, pressure, Gyroscope - Vision based sensors- Smart sensors	
	TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

1. Peter Elgar , "Sensors for Measurement and Control", Addison-Wesley Longman Ltd, 1998.
2. A K Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Co, 2010.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin , "Robotics Engineering: An Integrated Approach", PHI Learning, New Delhi, 2009.
2. Patranabis D, "Sensors and Transducers", Prentice-Hall of India Private Limited, New Delhi, 2003.
3. Ernest O Doebelin, "Measurement systems Application and Design", Tata McGraw-Hill Book Company, 2010.
4. Robert B. Northrop, "Introduction to Instrumentation and Measurements", 3rd Edition, CRC Press, 2014.

17ECX24 – SENSORS AND ACTUATORS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To know the basics of the sensors, transmitters and transducers.	1.1	The students will be able to distinguish sensor, transmitter and transducer and how to implement in the circuits.	a,b,c
2.0	To learn the principle of operation and characteristics of capacitive and inductive transducers.	2.1	The students will be able to describe the principle of operation and characteristics of capacitive and inductive transducers.	a,b,c
3.0	To understand the basics of actuators and its types.	3.1	The students will be able to select actuators according to the needs.	a,b,c,d
4.0	To learn the concept of micro sensors and micro actuators.	4.1	The students will be able to illustrate micro sensors and micro actuators with their uses.	a,b,c,l
5.0	To understand the concepts of sensor materials and processing techniques.	5.1	The students will be able to demonstrate knowledge about the materials and processing techniques of sensors.	a,b,d

UNIT I - SENSORS	**(9)**
Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal.	
UNIT II - INDUCTIVE & CAPACITIVE TRANSDUCER	**(9)**
Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details and characteristics of Capacitive transducers – different types & signal conditioning- Applications: capacitor microphone, capacitive pressure sensor, proximity sensor.	
UNIT III - ACTUATORS	**(9)**
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.	
UNIT IV - MICRO SENSORS AND MICRO ACTUATORS	**(9)**
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memor y effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.	
UNIT V - SENSOR MATERIALS AND PROCESSING TECHNIQUES	**(9)**
Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Patranabis.D, “Sensors and Transducers”, Wheeler publisher, 1994.
2. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” Fourth edition, Springer, 2010.

REFERENCES:

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edit ion, Kluwer academic publishers, Springer, 1997.

17ECX25 – SMART SENSORS FOR HEALTH CARE APPLICATIONS				
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of the protein based biosensors.	**1.1**	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their applications.	**a,b,c**
2.0	To learn the working principle of DNA based biosensor.	**2.1**	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products.	**a,b,c**
3.0	To understand the concept of sensors in electro chemical applications.	**3.1**	The students will able to detect fluorescence, UV-Vis and electrochemical applications of biosensors.	**a,b,c,d**
4.0	To learn the processes involved in fabrication of biosensors.	**4.1**	The students will able to describe about the fabrication of biosensors and its applications.	**a,b,c,l**
5.0	To throw a light on the areas of research and emerging trends of sensors in healthcare industry.	**5.1**	The students will able to explore about the future research areas of sensors in healthcare.	**a,b,d,l**

UNIT I – PROTEIN BASED SENSORS FOR HEALTHCARE	**(9)**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nano crystalline Diamond thin film for processing.	
UNIT II – DNA BASED BIOSENSOR	**(9)**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors.	
UNIT III - ELECTRO CHEMICAL APPLICATION	**(9)**
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors.	
UNIT IV - FABRICATION OF BIOSENSORS	**(9)**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis.	
UNIT V – SMART SENSORS IN RESEARCH FOR HEALTHCARE	**(9)**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design - Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004.

REFERENCES:

1. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
2. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

17ECX26 – PRINCIPLES OF ROBOTICS					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To know the basic concepts of Robotics.	**1.1**	The students will be able to understand basic concept of Robotics.		**a,b,c**
2.0	To learn the architecture and topology of software defined radio.	**2.1**	The students will be able to analyze homogenous transformations for Robotics.		**a,b,c,d**
3.0	To understand the concept of direct kinematics.	**3.1**	The students will be able to apply direct kinematics in the design of a bot.		**b,c,d,g,h**
4.0	To learn the the concept of inverse kinematics.	**4.1**	The students will be able to apply inverse kinematics in the design of a bot.		**a,b,c,j,k,l**
5.0	To understand the concept of velocity kinematics.	**5.1**	The students will be able to apply velocity kinematics in the design of a bot.		**a,b,d,g,j,l**

UNIT I – BASIC CONCEPTS	**(9)**
Classification of Robots based on Geometry, Workspace, Actuation, Control and Application - Advantages and Disadvantages of Robots - Robot Components: Link, Joint, Manipulator, Wrist, End-effector : Gripper – Types, Actuator and Sensor - Configuration space – Joint Space – Workspace, Robot Specifications: Number of Axes: Internal and External (7-axis robot) - Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision and Accuracy, Operating Environment	
UNIT II – HOMOGENEOUS TRANSFORMATIONS	**(9)**
Degrees of Freedom – Matrix Representation: Representation of a point and vector in space, Global and Local Coordinate axes - Homogeneous Transformation Matrices – Transformations: Representation of pure translation, Representation of pure Rotation - Representation of Combined Transformations - Inverse of Transformation Matrices - Euler Angles – Roll, Pitch, Yaw angles - Quaternions– Spinors and Rotators	
UNIT III - DIRECT KINEMATICS	**(9)**
Denavit- Hartenberg Notation - Transformation between two Adjacent Coordinate Frames, Forward Kinematics of Two, Three, Four, Five and Six axis Robots.	
UNIT IV - INVERSE KINEMATICS	**(9)**
Decoupling Technique - Inverse Transformation Technique - Inverse position: Geometric Approach –Inverse Orientation -Inverse Kinematics of Two, Three, Four, Five and Sixaxis Robots	
UNIT V - VELOCITY KINEMATICS	**(9)**
Angular Velocity – Linear Velocity - Jacobian representation of Linear and Angular Velocity Calculation of Jacobian for Two, Three and Four axis Robots - Inverse Jacobian - Singularities: Wrist and Arm Singularities - Manipulability - Induced joint torques and forces.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", Wiley, 2012.
2. Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley & Sons Inc, 2011.

REFERENCES:

1. Robert J. Schilling, "Fundamentals of Robotics, Analysis and Control", PHI Learning, 2009.
2. Reza N Jazar, "Theory of Applied Robotics", Springer, 2010.
3. Saha S K, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.
4. Tadej Bajd, Matjaž Mihelj, Marko Munih, "Introduction to Robotics", Springer, 2013.

17ECX27– ROBOTICS AND CONTROL- THEORY AND PRACTICE					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program Outcomes**	
1.0	To know the basic concept of various controls in Robotics.	**1.1**	The students will be able to understand basic concept of various controls in Robotics.	**a,b,c**	
2.0	To learn the various controls for Robot manipulator.	**2.1**	The students will be able to analyze manipulator control and their various applications.	**a,b,f**	
3.0	To understand the differential motion and statics in Robotics.	**3.1**	The students will be able to describe the differential motion and statics in Robotics.	**b,c,d,g,h**	
4.0	To learn the various exoskeletons for Robot.	**4.1**	The students will be able to design various exoskeletons for Robot.	**a,b,c,j**	
5.0	To understand the different percutaneous interventions.	**5.1**	The students will be able to apply various control modes in Robots.	**a,b,d**	

UNIT I – INTRODUCTION	**(9)**
Coordinate Frames and Homogeneous Transformations, Differential Transformations, Transforming Differential Changes between Coordinate Frames, Kinematic Model for Robot Manipulator – Direct and Inverse Kinematics, Manipulator Jacobian, Trajectory Planning, Manipulator Dynamics Multiple Degree of Freedom, Stability of Dynamical System	
UNIT II - MANIPULATOR CONTROL	**(9)**
Biped Robot Basics and Flat Foot Biped Model, Biped Robot Flat Foot and Toe Foot Model, Artificial Neural Network, Neural Network based control for Robot Manipulator.	
UNIT III - MANIPULATOR DIFFERENTIAL MOTION AND STATICS	**(9)**
Redundancy Resolution of Human Fingers in Cooperative Object Translation, Fundamentals of Robot Manipulability, Manipulability Analysis of Human Fingers in Cooperative Rotational Motion.	
UNIT IV - ROBOTIC EXOSKELETONS	**(9)**
Introduction to Robotic Hand Exoskeleton, Design and Development of a Three Finger Exoskeleton, Force Control of an Index Finger Exoskeleton, Neural Control of a Hand Exoskeleton, Neural Control of a Hand Exoskeleton Based on Human Subject's Intention.	
UNIT V – PERCUTANEOUS INTERVENTIONS	**(9)**
Robot Assisted Percutaneous Interventions, Sliding Mode Control, Higher Order Sliding Mode Control, Smart Needles for Percutaneous Interventions, Flexible Link Kinematics, Model Based Control of Robot Manipulators.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2. JohnJ.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.

17ECX28– PROGRAMMING FOR ROBOTICS					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To know the basics of the Robot Programming.	**1.1**	The students will be able to write small programs to control various components.		**a,b,c**
2.0	To learn the structure of VAL programs for simple applications.	**2.1**	The students will be able to execute VAL programs for various simple applications.		**a,b,c,d**
3.0	To understand the various commands in RAPID language.	**3.1**	The students will be able to execute programs in RAPID language for various simple applications.		**b,c,d**
4.0	To learn the cognitive radio architecture.	**4.1**	The students will be able to execute VAL programs for various simple applications.		**a,b,c,d,l**
5.0	To understand the concepts of wireless networks and next generation networks.	**5.1**	The students will be able to execute VAL programs for various simple applications.		**a,b,d,i,j,l**

UNIT I – BASICS OF ROBOT PROGRAMMING	**(9)**
Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-Interpolation-Interlock commands-Operating mode of robot, Jogging Types, Robot specifications- Motion commands, end effectors and sensors commands.	
UNIT II - VAL LANGUAGE	**(9)**
Robot Languages-Classifications, Structures- VAL language commands- motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications.	
UNIT III - RAPID LANGUAGE	**(9)**
RAPID language basic commands- Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Movemaster command language-Introduction, syntax, simple problems.	
UNIT IV - PRACTICAL STUDY OF VIRTUAL ROBOT	**(9)**
Robot cycle time analysis-Multiple robot and machine Interference-Process chart, Simple problems-Virtual robotics, Robot studio online software-Introduction, Jogging, components, work planning, program modules, input and output signals-Singularities. Collision detection-Repeatability measurement of robot-Robot economics.	
UNIT V – VAL-II AND AML	**(9)**
VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor commands-Data processing.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Deb. S. R. “Robotics Technology and Flexible Automation”, Tata McGraw Hill publishing company limited, 1994.
2. Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.

REFERENCES:

1. Klafter. R.D, Chmielewski.T.A and Noggin's, "Robot Engineering : An Integrated Approach", Prentice Hall of India Pvt. Ltd.,1994.
2. Fu .K. S, Gonzalez .R. C. & Lee .C.S.G, "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book co, 1987.
3. Craig .J. J, "Introduction to Robotics Mechanics and Control", Addison- Wesley, 1999.

17ECX29 – AI FOR ROBOTICS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of AI and intelligent agents.	1.1	The students will be able to search solution through uninformed and informed search strategies.	a,b,c
2.0	To learn the architecture and attributes of Robotic Paradigms.	2.1	The students will be able to select the proper Robotic paradigm.	a,b,f
3.0	To understand various topological and metric path planning methods.	3.1	The students will be able to design various metric path planning methods for Robotics.	b,c,d,g,h
4.0	To learn the sonar sensor model and map making.	4.1	The students will be able to apply various sonar sensor models for map making.	a,b,c,j,k,l
5.0	To understand the concepts of learning and natural language processing.	5.1	The students will be able to implement speech recognition techniques in bots.	a,b,d,g,i,j,l

UNIT I – INTRODUCTION TO AI AND INTELLIGENT AGENTS	**(9)**
Foundations, History - Intelligent agents, Agents - Nature of Environments, Structure of agents - Problem solving agents - Problem formulation - State space, Search space - Problem reduction - Searching for solutions: Uninformed search strategies – Informed search strategies - Heuristic functions	
UNIT II – ROBOTIC PARADIGMS	**(9)**
Overview of the Three Paradigms - Hierarchical Paradigm: attributes – representative architectures - Reactive paradigm: attributes - subsumption architecture - potential field methodologies - Designing a reactive implementation: a primitive move-to-goal behavior, an abstract follow-corridor behavior - Designing a Reactive Behavioral System - The Hybrid Deliberative/Reactive Paradigm- Attributes - Architectural Aspects- Managerial Architectures- State-Hierarchy Architectures Model-Oriented Architectures	
UNIT III – TOPOLOGICAL AND METRIC PATH PLANNING	**(9)**
Landmarks and gateways - relational methods – associative methods - case study - Metric Planning: Configuration Space-Cspace representations - graph based planners - wavefront based planners - Interleaving Path Planning and Reactive Execution	
UNIT IV – LOCALIZATION AND MAP MAKING	**(9)**
Sonar sensor model - Bayesian – Dampster-Shafer theory - HIMM - comparison of methods - localization – exploration	
UNIT V – LEARNING AND NATURAL LANGUAGE PROCESSING	**(9)**
Forms of learning - NLP: Language models - Natural language for communications - Speech recognition	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000.
2. Start Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, New Delhi, 2015

REFERENCES:

1. Francis X. Govers, "Artificial Intelligence for Robotics", Packt, 2018.
2. Roland Siegwart, Illah R. Nourbakhsh , "Introduction to Autonomous Mobile Robots", MIT Press, 2004.
3. Kevin Knight, Elaine Rich, Nair, "Artificial Intelligence", Tata McGraw Hill, New Delhi, 2017.

17ECX30 – ROBOTICS FOR INDUSTRIAL APPLICATIONS			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the scope and need for industrial robots.	1.1	The students will be able to comprehend and appreciate the significance and role of industrial robot in the present contemporary world.	a,b,c
2.0	To learn the fundamentals of automation and Robots.	2.1	The students will be able to exemplify the features and functionalities of the sensors in Robot.	a,b,f
3.0	To understand the basics of Robot programming.	3.1	The students will be able to develop different language programs to design and develop robotic based systems.	b,c,d,g,h
4.0	To learn the design and control of Robot cell design.	4.1	The students will be able to develop system for industrial automation and medical applications.	a,b,c,j,k,l
5.0	To understand the concepts of future robot technology.	5.1	The students will be able to illustrate the methodologies to provide automatic solution for replacing humans in life threatening area.	a,b,d,g,i,j,l

UNIT I – SCOPE OF ROBOTS	**(9)**
The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots -Economic and Social Issues, applications.	
UNIT II – ROBOT COMPONENTS	**(9)**
Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume -Precision of movement - End effectors - Sensors.	
UNIT III – ROBOT PROGRAMMING	**(9)**
Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages.	
UNIT IV – ROBOT WORK CELL	**(9)**
Robot Cell Design and Control - Remote Center compliance - Safety in Robotics.	
UNIT V – FUTURE TRENDS	**(9)**
Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.
2. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.

REFERENCES:

1. Mikell P.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Company 1986.
2. John Iovine, "Robots, Android and Animatronics", Second Edition, McGraw-Hill, 2012.

17ECX31– IMAGE SIGNAL PROCESSING			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To study the image fundamentals necessary for image processing.	1.1	The students will be able to know the image formation and the role human visual system plays in perception of Gray and color image data.	a,bi,j,l
2.0	To enable the student to know about unitary transforms and its properties.	2.1	The students will be able to apply transform-domain representation of images.	a,b,c,f,j
3.0	To study the concept of enhancement and restoration techniques.	3.1	The students will be able to perform image analysis by designing spatial and frequency domain filters.	b,c,d,k,l
4.0	To study the concept of compression and segmentation techniques.	4.1	The students will be able to describe how digital images are represented and stored efficiently depending on the desired quality	a,b,c,d,k
5.0	To understand the concepts of color image processing.	5.1	The students will be able to apply various techniques for color mage processing.	a,b,i,j,l

UNIT I – DIGITAL IMAGE FUNDAMENTALS AND MATRIX THEORY	**(9)**
Digital Image fundamentals: representation, elements of visual perception, simple image formation model, image sampling and quantization, basic relationship between pixels, imaging geometry Review of Matrix theory results: Row and Column ordering, Doubly Block Toeplitz for 2 D linear convolution, Doubly Block Circulant Matrices for circular convolution, Kronecker products, Unitary and orthogonal matrices	
UNIT II - UNITARY TRANSFORMS FOR IMAGE PROCESSING	**(9)**
General Unitary Transforms, DFT, DCT, DST, Hadamard Transform, Haar Transform, Karhunen Loeve Transform.	
UNIT III - IMAGE ENHANCEMENT AND RESTORATION	**(9)**
Spatial Domain enhancement: gray level transformations–histogram equalization-Image averaging-Spatial filtering: Smoothing, Sharpening filters- Frequency domain filters: Smoothing-Sharpening filters-Homomorphic filtering. Image Restoration: Degradation model-Unconstrained and Constrained restoration-Inverse filtering-Wiener filtering.	
UNIT IV - IMAGE COMPRESSION AND SEGMENTATION	**(9)**
Need for data compression-Error free compression-Variable length coding-Bit-Plane coding-Lossless and Lossy Predictive coding, JPEG and MPEG Compression Standards. Image Restoration: Point- Line and edge detection-Thresholding – Region based segmentation: Region splitting and merging.	
UNIT V – COLOR IMAGE PROCESSING	**(9)**
Color models- RGB, CMY, YIQ, HIS, Pseudo coloring, intensity slicing, gray level to color transformation.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Digital Image Processing- Gonzalez and Woods, Pearson education, 2002.
2. Fundamentals of Digital Image Processing – A K Jain, Pearson education, 2003.

REFERENCES:

1. Digital Image Processing- W K Pratt, John Wiley, 2004
2. Digital Signal and Image Processing- Tamal Bose, John Wiley publishers.
3. Two dimensional signal and Image Processing- J S Lim, Prentice Hall.

17ECX32– DIGITAL VIDEO SIGNAL PROCESSING					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**			**Related Program Outcomes**
1.0	To study the basic steps involved in video processing.	**1.1**	The students will be able to analyze the various image formation models for video.		**a,b,c**
2.0	To enable the student to know about Various motion estimation and detection schemes.	**2.1**	The students will be able to apply transform-domain representation of images.		**a,b,f**
3.0	To understand the different coding methods to be applied for video.	**3.1**	The students will be able to apply various coding techniques for motion estimation.		**b,c,d,g,h**
4.0	To explore the concept of video segmentation, tracking and optimization.	**4.1**	The students will be able to track video with 2D, 3D motion using various methods.		**a,b,c,j,k,l**
5.0	To throw light on real time applications of video processing.	**5.1**	The students will be able to apply video processing techniques for real time applications.		**a,b,d,g,i,j,l**

UNIT I – BASIC STEPS OF VIDEO PROCESSING	**(9)**
Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.	
UNIT II - 2-D MOTION DETECTION AND ESTIMATION	**(9)**
Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion detection and estimation, Motion Compensated Filtering.	
UNIT III - WAVEFORM BASED CODING	**(9)**
Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.	
UNIT IV – VIDEO SEGMENTATION, TRACKING AND OPTIMIZATION	**(9)**
Video Segmentation, Motion Segmentation, Motion Tracking in Video, 2D and 3D Motion Tracking in Digital Video, Methods using Point Correspondences, Optical Flow and Direct Methods, Pel-Recursive Methods, Bayesian Methods	
UNIT V – APPLICATIONS	**(9)**
Video Stabilization and Mosaicing, A Unified Framework for Video Indexing, Summarization, Browsing and Retrieval, Video Surveillance	
	TOTAL (L:45) = 45 PERIODS
TEXT BOOKS: 1. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI.	
REFERENCES: 1. M. Tekalp ,"Digital video Processing", Prentice Hall International.	

17ECX33 – DIGITAL SPEECH PROCESSING				
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To study the basic concepts and models Speech signal processing.	**1.1**	The students will be able to analyze the various models for speech signal.	**a,b,c**
2.0	To enable the student to know about various time domain models of Speech signals.	**2.1**	The students will be able to process the speech signal using different time domain models.	**a,b,f**
3.0	To understand the short time Fourier analysis for speech signal.	**3.1**	The students will be able to apply short time Fourier analysis for speech signal.	**b,c,d,g,h**
4.0	To explore the various concepts of Linear Predictive coding and its applications.	**4.1**	The students will be able to solve LPC using different methods and use in real time applications.	**a,b,c,j,k,l**
5.0	To throw light on various speech recognition methods.	**5.1**	The students will be able to apply speech processing techniques for real time applications.	**a,b,d,g,i,j,l**

UNIT I – SPEECH SIGNAL MODELS	**(9)**
Introduction: Speech Signal characteristics - Overview of Digital Speech Processing - Speech Production Mechanism - Acoustic Theory of Speech Production: Sound Propagation, Effects of Losses in Vocal Tract, Vocal Tract Transfer Function for Vowels, Sound Excitation in Vocal Tract-Lossless Tube Models: Wave Propagation, Boundary Conditions, Transfer functions, Sound Excitation in Vocal Tract – Digital Models for Speech Signal: Vocal Tract, Radiation, Excitation, Complete Model.	
UNIT II - TIME DOMAIN MODELS	**(9)**
Time Dependent Processing of Speech - Short Time Energy and Average Magnitude - Short time Zero Crossing Rate - Pitch Period Estimation - Short time Auto correlation Function - Median Smoothing.	
UNIT III - SHORT TIME FOURIER ANALYSIS	**(9)**
Definitions and Properties - Design of Digital Filter Banks: Filter design using IIR and FIR filters – Pitch Detection - Analysis-by-Synthesis - Homomorphic Speech Processing: Complex Cepstrum, Formant Estimation, Homomorphic Vocoder.	
UNIT IV – LINEAR PREDICTIVE CODING	**(9)**
Basic Principle - Solution of LPC equations: Cholesky decomposition method, Durbin"s method, Lattice formulation - Frequency domain interpretation of Linear Predictive Analysis - Relation between various Speech Parameters - Applications of LPC: Pitch Detection, Formant Analysis, LPC Voder, Voice Excited LPC Vocoder.	
UNIT V – SPEECH PROCESSING FOR MAN-MACHINE COMMUNICATION	**(9)**
Voice Response Systems - Speaker Recognition Systems: Speaker Verification and Identification Systems - Speech Recognition Systems: Isolated Digit Recognition, Continuous Digit Recognition, Large Vocabulary Word Recognition System.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rabiner L R and Schaffer R W, Digital Processing of Speech Signals, Pearson Education - India, New Delhi, 2010.
2. Thomas F Quatieri, Discrete Time Speech Signal Processing, Pearson Education - India, New Delhi, 2011.

REFERENCES:

1. Owens FJ, Signal Processing of Speech, Macmillan, New York, 2013.
2. Rabiner L R and K Juang B H, Fundamentals of speech Recognition, Pearson Education - India, New Delhi, 2011.
3. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.

17ECX34 – PATTERN RECOGNITION

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To study the basic of pattern recognition and different algorithms.	1.1	The students will be able to analyze the pattern recognition algorithms for classifications.	a,b,c,d,e,f,l
2.0	To know the various methods involved in unsupervised classification.	2.1	The students will be able to apply the unsupervised learning techniques for pattern classification.	a,b,c,d,e,f,l
3.0	To understand the different structural pattern recognition methods.	3.1	The students will be able to explain the concepts of structural pattern recognition.	a,b,c,d,e,f,l
4.0	To explore the concept of feature extraction and selection methods.	4.1	The students will be able to analyze the feature extraction and selection techniques.	a,b,c,d,e,f,l
5.0	To throw light on non-metric methods for pattern classification.	5.1	The students will be able to analyze the advanced neural network structures for pattern recognition.	a,b,c,d,e,f,l

UNIT I – PATTERN CLASSIFIER	**(9)**
Overview of pattern recognition - Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation - Bayesian parameter estimation - Perceptron algorithm - LMSE algorithm -Problems with Bayes approach - Pattern classification by distance functions - Minimum distance pattern classifier.	
UNIT II - UNSUPERVISED CLASSIFICATION	**(9)**
Clustering for unsupervised learning and classification - Clustering concept - C-means algorithm - Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solutions.	
UNIT III – STRUCTURAL PATTERN RECOGNITION	**(9)**
Elements of formal grammars - String generation as pattern description - Recognition of syntactic description -Parsing - Stochastic grammars and applications.	
UNIT IV – FEATURE EXTRACTION AND SELECTION	**(9)**
Entropy minimization - Karhunen - Loeve transformation - Feature selection through functions approximation -Binary feature selection.	
UNIT V – NON-METRIC METHODS FOR PATTERN CLASSIFICATION AND APPLICATIONS	**(9)**
Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART). Applications: Face recognition - preprocessing, face detection algorithms, selection of representative patterns, classification algorithms, results and discussion.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2001.
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.

REFERENCES:

1. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. P.A Devijver and J. Kittler, Pattern Recognition: A Statistical Approach, Prentice-Hall International, Englewood Cliffs, NJ, 1980
3. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Ed. Academic Press, New York, 1990.

17ECX35 – MEDICAL IMAGE ANALYSIS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To know the medical imaging techniques for image acquisition.	**1.1**	The students will be able to identify the nuclear medical imaging techniques for acquisition of images.	**a,b,c,d,e,l**
2.0	To learn the mathematical preliminaries for image reconstruction.	**2.1**	The students will be able to apply 2D and 3D transforms required for image reconstruction.	**a,b,c,d,e,l**
3.0	To understand the design of fluoroscopy, CT, X-ray and image quality influences.	**3.1**	The students will be able to analyze the x-ray medical imaging techniques and its imaging quality.	**a,b,c,d,e,l**
4.0	To learn the concepts of MRI and spectroscopy..	**4.1**	The students will be able to apply the concept of Neuro Magnetic Science in MRI.	**a,b,c,d,e,l**
5.0	To understand the concepts of ultrasound and neuromagnetic imaging.	**5.1**	The students will be able to analyze the principle and operation modes of Ultrasound Imaging.	**a,b,c,d,e,l**

UNIT I – ACQUISITION OF IMAGES	**(9)**
Introduction to Imaging Techniques - Single crystal scintillation camera - Principles of scintillation camera - multiple crystal scintillation camera - solid state camera - rectilinear scanner- Emission computed Tomography.	
UNIT II - MATHEMATICAL PRELIMINARIES FOR IMAGE RECONSTRUCTION	**(9)**
Image Reconstruction from Projections in Two dimensions- Mathematical Preliminaries for Two and Three dimensional Image Reconstructions - Radon Transform- Projection Theorem - central slice Theorem- Sinogram- Two Dimensional Projection Reconstruction- Three Dimensional Projection Reconstruction- Iterative Reconstruction Techniques.	
UNIT III – FLUOROSCOPY, CT, IMAGE QUALITY	**(9)**
Digital fluoroscopy- Automatic Brightness control - cinefluorography- Principles of computed Tomographic Imaging - Reconstruction algorithms - Scan motions- X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise.	
UNIT IV – MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY	**(9)**
Fundamentals of magnetic resonance- overview -Pulse techniques- spatial encoding of magnetic resonance imaging signal- motion suppression techniques- contrast agents- tissue contrast in MRI- fMRI.	
UNIT V - ULTRASOUND, NEUROMAGNETIC IMAGING	**(9)**
Ultrasound: Presentation modes- Time required to obtain Images- System components, signal processingdynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems.	
	TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

1. J William R. Hendee, E. Russell Ritenour, Medical Imaging Physics: A John Wiley & sons, Inc., Publication, Fourth Edition 2002.
2. A. C. Kak and M. Slaney, Principles of Computerized Tomography, Society of Industrial and Applied Mathematics, 2001.

REFERENCES:

1. Z.H. Cho., J-oie, P. Jones and Manbir Singh,Foundations of Medical Imaging: John Wiley and sons Inc.
2. Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, Newyork-1998.

17ECX37 – COMPUTER VISION

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To know the basics of Embedded systems and programming.	1.1	The students will be able to interpret the architecture and instruction sets in Embedded systems.	a,b,c
2.0	To learn various techniques in Embedded programming.	2.1	The students will be able to write programs using registers and interrupts.	a,b,f
3.0	To understand the programming for various applications.	3.1	The students will be able to implement programming for various applications.	b,c,d,g,h
4.0	To learn the integration of hardware and software of embedded systems.	4.1	The students will be able to interface hardware and software and embed program to the target system.	a,b,c,j,k,l
5.0	To understand the concepts of Real time operating Systems.	5.1	The students will be able to do programming for RTOS.	a,b,d,g,i,j,l

UNIT I – INTRODUCTION **(9)**

Embedded system overview and applications - features and architecture considerations-ROM - RAM - timers - data and address bus - Memory and I/O interfacing concepts - memory mapped I/O. CISC Vs RISC design philosophy - Von-Neumann Vs Harvard architecture - instruction set - instruction formats - and various addressing modes. Fixed point and floating point arithmetic operations.

UNIT II – BASIC EMBEDDED PROGRAMMING TECHNIQUES **(9)**

Introduction to TIVAARM Cortex M4 - Key Features - Functional Block Diagram - Pin Configuration - I/O pin multiplexing - pull up/down registers - GPIO control - Memory Mapped Peripherals - programming System registers - Watchdog Timer - need of low power for embedded systems - System Clocks and control - Hibernation Module on Tiva - Active vs Standby current consumption. Introduction to Interrupts - Interrupt vector table - interrupt programming.

UNIT III – TIMERS, PWM AND MIXED SIGNAL PROCESSING **(9)**

Timer - Basic Timer - Real Time Clock (RTC) - Timing generation and measurements - Analog interfacing and data acquisition: ADC - Analog Comparators - DMA - Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

UNIT IV – HARDWARE/SOFTWARE INTEGRATION **(9)**

Host and Target Machines. In-System Programming (ISP)-In-Application Programming (IAP)-Getting Embedded Software into Target System: Programmers. Display - Keyboard - Relay - Stepper and DC Motor Interfacing.

UNIT V – REAL TIME OPERATING SYSTEMS **(9)**

Survey of Software Architectures - Tasks and Task States - Tasks and Data - Semaphores and Shared Data - Message Queues - Mailboxes and Pipes - Timer functions - Events - Memory Management and Interrupt Routines in RTOS Environment. Study of embedded product design with real time concepts using RTOS.

TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

1. Jonathan W Valvano, "Introduction to Arm Cortex -M Microcontrollers", 2012.
2. David E Simon, "An Embedded Software Primer", Pearson Education Asia, 2009.

REFERENCES:

1. Rajkamal, "Embedded Systems: Architecture, Programming and Design", Tata McGraw-Hill, 2008.
2. Andrew Sloss & Dominic Symes & Chris Wright, "ARM System Developer's Guide", 1st Edition, Elsevier, Morgan Kaufmann Publishers 2004.

17ECX38 – DEEP LEARNING FOR VISUAL COMPUTING			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of machine learning principles.	1.1	The students will be able to infer the mathematical background and significance of Machine Learning Principles.	a,b,c
2.0	To learn the basics of neural networks.	2.1	The students will be able to apply the mathematical background and significance of Artificial Neural Networks in Deep Learning.	a,b,f
3.0	To understand the operation of ANN for deep learning.	3.1	The students will be able to analyze the operation of ANN for Deep Learning.	b,c,d,g,h
4.0	To learn the supervised and unsupervised models of ANN.	4.1	The students will be able to analyze the Supervised and Unsupervised models of ANN for Deep Learning.	a,b,c,j,k,l
5.0	To understand the concepts of real world applications of Deep Learning.	5.1	The students will be able to analyze the recent developments and real world examples of Deep Learning Networks.	a,b,d,g,i,j,l

UNIT I – INTRODUCTION TO MACHINE LEARNING	**(9)**
Overview of machine learning, linear classifiers, loss functions, Stochastic gradient descent and contemporary variants, back-propagation.	
UNIT II – INTRODUCTION TO NEURAL NETWORKS	**(9)**
Activation functions, initialization, regularization, batch normalization, model selection, ensembles, Fundamentals, architectures, pooling, visualization.	
UNIT III – NEURAL NETWORK IN ACTION	**(9)**
Transposed convolution, efficient pooling, object detection, semantic segmentation, Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, learning from descriptions, attention.	
UNIT IV – DEEP GENERATIVE MODELS	**(9)**
Auto-encoders, variational auto-encoders, generative adversarial networks, autoregressive models, generative image models, unsupervised and self-supervised representation learning.	
UNIT V – DEEP REINFORCEMENT LEARNING	**(9)**
Policy gradient methods, Q-Learning, Real World Applications of Deep Learning Techniques.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.

REFERENCES:

1. K. P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

17ECM01 – FUNDAMENTALS OF SEMICONDUCTOR DEVICES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
COURSE OBJECTIVES AND OUTCOMES:					
Course Objectives		**Course Outcomes**		**Related Program Outcomes**	
1.0	To know the basics of electronic states and energy band structure formation.	**1.1**	The students will be able to know basics of electronic states and energy band structure formation.	**a,b,c**	
2.0	To know the importance of carrier concentration and doping in semiconductors.	**2.1**	The students will be able to know the importance of carrier concentration and doping in semiconductors.	**a,b,c**	
3.0	To understand physics of transport of charge carriers.	**3.1**	The students will be able to understand physics of transport of charge carriers.	**a,b,c**	
4.0	To understand physics of transport of charge carriers.	**4.1**	The students will be able to know the importance of optical properties of materials.	**a,b,c**	
5.0	To understand the concepts of physics of devices and importance of quantum structures.	**5.1**	The students will be able to understand the.	**a,b,c**	

UNIT I – ELECTRONIC STATES	**(9)**
Crystal structures -reciprocal lattice – Brillouin zone and band representation. Dynamics of electrons in periodic potential: Kronig-Penny and nearly free electron models – band structure calculations -band structures of real semiconductors. Band gaps in semiconductors: Holes and effective mass concept – properties of conduction and valence bands.	
UNIT II - CARRIERS AND DOPING	**(9)**
Fermi distribution and energy – Density of states – valence and conduction band density of states – intrinsic concentration – intrinsic Fermi level – n and p type doping – density of carriers in extrinsic semiconductors and their temperature dependence – extrinsic semiconductor Fermi energy level – degenerate and non-degenerate semiconductors – band-gap engineering –electrons and holes in quantum wells and superlattices.	
UNIT III – ELECTRICAL TRANSPORT	**(9)**
Scattering in semiconductors – Velocity-electric field relations: Low field response; mobility and high field transport. Very high field transport: Breakdown phenomena – avalanche breakdown - Zener tunneling. Carrier transport by diffusion – transport by drift and diffusion: Einstein's relation. Charge injection and quasi-Fermi levels.	
UNIT IV – OPTICAL TRANSPORT	**(9)**
Electron –hole pair generation and recombination: band to band and intra band transitions, free – carrier and phonon transitions. Excitons: Origin, electronic levels and properties. Radiative recombination (Shockely – Read- Hall and Auguer) processes. Carrier transport: continuity equations. Optical constants: Kramers – Kronigrelations – Electron-phonon interaction – Semiconductor laser.	
UNIT V - DEVICES	**(9)**
Processing of semiconductor devices: crystal growth, doping, deposition of dielectric films, lithography and metallization – p-n semiconductor junctions – homo and hetero junctions. MOS diode and MOSFET. Semiconductor quantum structures, density of states and excitons. Semiconductor photonic structures: 1D, 2D and 3D photonic crystals. Active and passive optoelectronic devices: photo processes.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. R.F.Pierret, "Semiconductor Device Fundamentals", Pearson, 2006.
2. D.Neamen and D.Biswa, "Semiconductor physics and devices", McGraw Hill Education, 2017.

REFERENCES:

1. N.Garcia, A. Damask and S.Schwarz “Physics for Computer Science Students”, SpringerVerlag, 2012.
2. Umesh Mishra and Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Nandita Dasgupta and Amitava Dasgupta, “Semiconductor Devices: Modelling and Technology”, PHI Learning Pvt. Ltd., 2004.

17ECM02 – SEMICONDUCTOR DEVICES AND CIRCUITS			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of the software defined radio.	1.1	Know basics of electronic states and energy band structure formation.	a,b,c
2.0	To learn the architecture and topology of software defined radio.	2.1	Know the importance of carrier concentration and doping in semiconductors.	a,b,f
3.0	To understand the design of the wireless networks based on the cognitive radios	3.1	Understand physics of transport of charge carriers.	b,c,d,g,h
4.0	To learn the cognitive radio architecture.	4.1	Know the importance of optical properties of materials.	a,b,c,j,k,l
5.0	To understand the concepts of wireless networks and next generation networks.	5.1	Understand the physics of devices and importance of quantum structures.	a,b,d,g,i,j,l

UNIT I - SEMICONDUCTOR DIODES	**(9)**
PN junction diode - Current equations - Diffusion and Drift Current Densities - Forward and Reverse bias characteristics - Switching Characteristics.	
UNIT II - BIPOLAR JUNCTION TRANSISTIORS	**(9)**
NPN and PNP – Junctions - Early effect - Current equations – Input and Output characteristics of CE, CB, CC Configurations - Hybrid -π model - Ebers Moll Model - Transistor as an amplifier.	
UNIT III -FIELD EFFECT TRANSISTORS	**(9)**
JFET – Drain and Transfer Characteristics - Current equations - Pinch off voltage and its significance, MOSFET – Characteristics - Threshold voltage - Channel length modulation - D-MOSFET - E-MOSFET Current equation - FINFET - DUAL GATE MOSFET.	
UNIT IV - SPECIAL SEMICONDUCTOR DEVICES	**(9)**
Metal-Semiconductor Junction – MESFET – Schottky barrier diode - Zener diode - Varactor diode – Tunnel diode – PIN diode - LASER diode - LDR.	
UNIT V - POWER DEVICES AND DISPLAY DEVICES	**(9)**
UJT - SCR - Diac - Triac - Power BJT - Power MOSFET - DMOS – VMOS, LED – LCD - Photo transistor - Opto-Coupler - Solar cell - CCD.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. R David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth Edition, (2008).
2. Jacob Millman & Christos C. Halkias, "Electronic Devices and Circuits", McGraw Hill, 2nd Edition, 2007.
3. D.Neamen and D.Biswa, "Semiconductor physics and devices", McGraw Hill Education, 2017.

REFERENCES:

1. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill Third Edition (2013).
2. R.L. Boylestad & L. Nashelsky, "Electronic Devices and Circuit Theory", PHI Learning Private Limited, Ninth Edition, 2008.

17ECM03 – SEMICONDUCTOR DEVICE MODELLING AND SIMULATION			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To know the basics of the software defined radio.	**1.1**	Know basics of electronic states and energy band structure formation.	**a,b,c**
2.0	To learn the architecture and topology of software defined radio.	**2.1**	Know the importance of carrier concentration and doping in semiconductors.	**a,b,f**
3.0	To understand the design of the wireless networks based on the cognitive radios	**3.1**	Understand physics of transport of charge carriers.	**b,c,d,g,h**
4.0	To learn the cognitive radio architecture.	**4.1**	Know the importance of optical properties of materials.	**a,b,c,j,k,l**
5.0	To understand the concepts of wireless networks and next generation networks.	**5.1**	Understand the physics of devices and importance of quantum structures.	**a,b,d,g,i,j,l**

UNIT I – Si-BASED NANOELECTRONICS	**(9)**
Si-Based Nanoelectronics and Device Scaling, Nanoscale and Heterostructure Devices, Crystal structure-Unit cell and Miller Indices, Reciprocal Space, Doping, Band Structure, Effective Mass	
UNIT II - PN JUNCTION DIODE	**(9)**
Density of states, Electron Mobility, Semiconductor Statistics- Fermi-Dirac function and carrier concentration calculation, p-n junction under equilibrium, derivation of I-V relation, Minority carrier diffusion equation, Non-idealities in the p-n junction diode (Breakdown and Generation-Recombination currents).	
UNIT III - BIPOLAR JUNCTION TRANSISTIORS	**(9)**
Transistor configurations, BJT- I-V relation and gain, Ebers-Moll model, Non-idealities in BJT, Gummel Poon Model, HBT, BJT Transient and small signal behavior, Metal-Semiconductor contact (Schottky Barrier/Diode, Ohmic Contacts) and capacitance characteristics, Thermionic emission current flow and fermi-level pinning	
UNIT IV - FIELD EFFECT TRANSISTORS	**(9)**
Field Effect Transistors (JFET, MESFET, HEMT), MOS Band diagram and C-V characteristics, Threshold voltage and Interface charges, MOSFET I-V, gradual channel approximation and frequency response, non-idealities and CMOS	
UNIT V - SEMICLASSICAL TRANSPORT THEORY	**(9)**
Semiclassical Transport Theory -: Distribution Function, Boltzmann Transport Equation (BTE), Relaxation-Time Approximation (RTA), Scattering and Mobility. Drift-Diffusion Model Derivation and dielectric relaxation time, Taylor series expansion and Finite Difference method, Normalization, Scaling and Linearization of Poisson's Equation and Scharfetter–Gummel Discretization of the Continuity Equation	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. R David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth Edition, (2008).
2. Jacob Millman & Christos C. Halkias, "Electronic Devices and Circuits", McGraw Hill, 2nd Edition, 2007.

REFERENCES:

1. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, “Electronic Devices and Circuits”, Tata McGraw Hill Third Edition (2013).
2. R.L. oylestad & L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Private Limited, Ninth Edition, 2008.

17ECM05 – SEMICONDUCTOR OPTOELECTRONICS			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of light sources and semiconductor Physics.	1.1	The students will be able to describe various properties of light and semiconductor devices.	a,b,c
2.0	To learn the working principle of optical sources.	2.1	The students will be able to explain the working of different optical sources.	a,b,c
3.0	To understand the basic of optical detectors.	3.1	The students will be able to design optical detectors for the required applications.	a,b,c
4.0	To learn the construction and working of optoelectronic modulating devices..	4.1	The students will be able to design optoelectronic modulators.	a,b,c
5.0	To understand the concepts integrated optoelectronic circuits.	5.1	The students will be able to explore the concept of optoelectronic Integrated circuits.	a,b,c

UNIT I – LIGHT SOURCES AND SEMICONDUCTOR PHYSICS	**(9)**
Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.	
UNIT II – OPTICAL SOURCES	**(9)**
Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications.	
UNIT III – OPTICAL DETECTORS	**(9)**
Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.	
UNIT IV – OPTOELECTRONIC MODULATING DEVICES	**(9)**
Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, Switching and Logic Devices.	
UNIT V – INTEGRATED OPTOELECTRONIC CIRCUITS	**(9)**
Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. J. Wilson and J.Haukes, “Opto Electronics – An Introduction”, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.

REFERENCES:

1. Bhattacharya “Semiconductor Opto Electronic Devices”, Prentice Hall of India Pvt., Ltd., New Delhi, 1995.
2. Jasprit Singh, “Opto Electronics – As Introduction to materials and devices”, McGraw-Hill International Edition, 1998.

17ECM06 – MICRO ELECTRO MECHANICAL SYSTEMS			
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To introduce the concepts of micro electro mechanical devices.	1.1	The students will be able to describe the concepts of MEMS and its applications.	a,b,c,d
2.0	To understand the materials required for manufacturing MEMS.	2.1	The students will be able to choose required materials for manufacturing MEMS.	a,b,c,d
3.0	To know the fabrication process of microsystems.	3.1	The students will be able to design a system using MEMS components.	a,b,c,d
4.0	To understand the design concepts of micro sensors.	4.1	The students will be able to design various MEMS sensors.	a,b,c,d
5.0	To explore the design concepts of micro actuators.	5.1	The students will be able to design micro actuators.	a,b,c,d

UNIT I – INTRODUCTION	**(9)**
New trends in Engineering and Science: Micro scale systems-Introduction to Design of MEMS, Overview of Micro electro mechanical Systems, Applications of Micro electro mechanical systems.	
UNIT II – BASICS OF MEMS	**(9)**
Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.	
UNIT III – MEMS FABRICATION TECHNOLOGIES	**(9)**
Microsystem fabrication processes: clean room standards, Semiconductor wafer cleaning, Photolithography, Ion Implantation, Diffusion and Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining.	
UNIT IV – MICRO SENSORS	**(9)**
Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors.	
UNIT V – MICRO ACTUATORS	**(9)**
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. J. 1 Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.
2. Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001

REFERENCES:

1. Ran Hsu,"MEMS and Microsystems Design and Manufacture", Tata Mcraw Hill, 2002.
2. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006

17ECM07 – AN INTRODUCTION TO ELECTRONIC SYSTEM PACKAGING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To know the basics of electronic system packing hierarchy.	**1.1**	The students will be able to apply the packaging hierarchy of electronic systems.	**a,b,c**
2.0	To learn the design methods of PCB fabrication.	**2.1**	The students will be able to design and manufacturing of printed circuit boards.	**a,b,c**
3.0	To understand the design rules to overcome EMI.	**3.1**	The students will be able to analyze the component packages available for a given application.	**a,b,c,d**
4.0	To learn the PCB assembly and soldering techniques.	**4.1**	The students will be able to apply the PCB assembly and soldering techniques.	**a,b,c,d**
5.0	To understand the fundamentals and standards of industrial design of electronic products.	**5.1**	The students will be able to design of product ergonomics and aesthetics.	**a,b,c**

UNIT I – PACKAGING OF ELECTRONIC SYSTEMS	**(9)**
Electronic systems and needs. Physical integration of circuits, packages, boards and full electronic systems, Connectivity in Electronic equipment, Study of Electronic components and its packaging. Package classifications (Through hole and SMDs) and packaging trends. Standards of packaging, Packaging hierarchy of Electronic Products and Systems, Hierarchy of Interconnection Levels.	
UNIT II - MANUFACTURING AND DESIGN OF SECOND LEVEL (PCB) BOARDS AND FABRICATION METHOD	**(9)**
Evolutions of Printed Circuit Boards, Classification of Printed Circuit Boards(Single Sided PC Boards, Double Sided PC Boards, Multilayer PC Boards) ,Challenges in Modern PCB Design and Manufacture, Major Market Drivers for PCB Industry, PCB for Electronic Systems. PCB design considerations/ design rules for analog, digital and power applications.	
UNIT III – ELECTROMAGNETIC COMPATIBILITY	**(9)**
Electromagnetic interference in electronic systems and its impact, Analysis of electronic circuit from noise emission point of view (both conducted and radiated emission) cross talk and reflection. Design rules to overcome EMI.	
UNIT IV – THERMAL DESIGN OF CHIPS AND BOARDS	**(9)**
Thermal management of electronic devices and systems, Overview. Thermal interface material. Heat density in electronic components, Heat transfer through conduction, convection and radiation, Heat sinks, Principle, Construction and materials. Performance, Method of cooling, Heat pipes, Peltier cooling plates. Recent developments, Application in Electronics Systems, Personal Computers, Batteries and Soldering.	
UNIT V - INDUSTRIAL DESIGN OF ELECTRONIC PRODUCTS	**(9)**
Fundamentals of Industrial Design, Industrial Design Process - Investigation of customer needs, Conceptualization, Preliminary refinement, Further refinement and final concept selection, Ergonomics, Aesthetics-Colour, Form, Type, Concurrent Engineering, Physical Design of Packaging Standards, Materials, Manufacturing, Rapid Prototyping.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS: 1. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw Hill, NY, 2001.
REFERENCES: 1. William D. Brown, Advanced Electronic Packaging, IEEE Press, 1999.

17ECM08 – SYSTEM ON A CHIP DESIGN				
L	T	P	C
3	0	0	3

PREREQUISITE : NIL

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program Outcomes
1.0	To know the basics of SOC design.	1.1	The students will be able to select the required processor for different applications.	a,b,c
2.0	To learn the architecture and topology of system level interconnection.	2.1	The students will be able to interconnect different buses and interfaces.	a,b,f
3.0	To understand the concept of codesign and modeling.	3.1	The students will be able to model an SOC using Codesign concepts.	b,c,d,g,h
4.0	To learn the tools for implementation of SOC.	4.1	The students will be able to implement SOC using RTOS	a,b,c,j,k,l
5.0	To understand the concepts testing in SOC.	5.1	The students will be able to validate the designed SOC.	a,b,d,g,i,j,l

UNIT I – SOC INTRODUCTION	**(9)**
Driving Forces for SoC- Components - Generic template- Design flow- Hardware/Software nature, Design Trade-Offs-Major Applications-SYSTEM-LEVEL DESIGN: Processor selection-Concepts in Processor Architecture: Instruction set architecture (ISA) -Robust processors: Vector processor, VLIW, Superscalar, CISC, RISC—Processor evolution: Soft and Firm processors, Custom-Designed processors-IP based design- on-chip memory.	
UNIT II - SYSTEM-LEVEL INTERCONNECTION	**(9)**
On-chip Buses: basic architecture, topologies, arbitration and protocols, Bus standards: AMBA, Core Connect, Wishbone, Avalon-Network-on-chip: Architecture-topologies-switching strategies- routing algorithms-flow control, quality-of-service-Re-configurability in communication architectures.	
UNIT III – CO-DESIGN CONCEPTS	**(9)**
Nature of hardware & software- quest for energy efficiency- driving factors for hardware- software codesign- Codesign space-Dualism of Hardware design and Software design-Modeling Abstraction Level-Concurrency and Parallelism-Hardware Software tradeoffs- Introducing Dataflow modelling.	
UNIT IV – SOC IMPLEMENTATION	**(9)**
Study of Microblaze RISC processor - Real-time operating system (RTOS), peripheral interface and components, High-density FPGAs-Introduction to tools used for SOC design: Xilinx SoC based development kit.	
UNIT V - SOC TESTING	**(9)**
Manufacturing test of SoC: Core layer, system layer, application layer-P1500 Wrapper Standardization-SoC Test Automation (STAT).	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Michael J.Flynn, Wayne Luk , "Computer system Design: System-on-Chip", Wiley-India, 2012.
2. Sudeep Pasricha, Nikil Dutt , "On Chip Communication Architectures: System on Chip Interconnect", Morghan Kaufmann Publishers, 2008.

REFERENCES:

1. W.H.Wolf , "Computers as Components: Principles of Embedded Computing System Design", Elsevier, 2008.
2. Patrick Schaumont , "A Practical Introduction to Hardware/Software Co-design", 2nd Edition, Springer, 2012.

NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi

for

B.E – Electronics and Communication Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year (2022-23) onwards)

August 2022

NANDHA ENGINEERING COLLEGE (AUTONOMOUS), ERODE – 638 052

REGULATIONS – R22 **CHOICE BASED CREDIT SYSTEM**

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22EYA01	Professional Communication - I	HSMC	-	4	2	0	2	3
2	22MYB01	Calculus and Linear Algebra	BSC	-	4	3	1	0	4
3	22CYB04	Engineering Chemistry	BSC	-	3	3	0	0	3
4	22CSC01	Problem Solving and C Programming	ESC	-	3	3	0	0	3
5	22ECC02	Basics of Electrical and Instrumentation Engineering	ESC	-	3	3	0	0	3
6	22GYA01	தமிழர்மரபு /Heritage of Tamils	HSMC	-	1	1	0	0	1
PRACTICALS									
7	22CSP01	Problem Solving and C Programming Laboratory	ESC	-	4	0	0	4	2
8	22CYP01	Chemistry Laboratory	BSC	-	2	0	0	2	1
9	22GEP01	Engineering Practices Laboratory	ESC	-	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
10	22MAN01	Induction Programme	MC	-	0	0	0	0	0
11	22MAN02	Soft /Analytical Skills - I	MC	-	3	1	0	2	0
12	22MAN03	Yoga - I	MC	-	1	0	0	1	0
				TOTAL	**31**	**15**	**1**	**15**	**22**

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22EYA02	Professional Communication- II	HSMC	22EYA01	4	2	0	2	3
2	22MYB04	Transforms Techniques and Partial Differential Equations	BSC	-	4	3	1	0	4
3	22PYB03	Solid State Physics	BSC	-	3	3	0	0	3
4	22CSC02	Data Structures using C	ESC		3	3	0	0	3
5	22ECC04	Electronic Devices and Circuits (Theory + Lab)	PCC	-	5	3	0	2	4
6	22GYA02	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	-	1	1	0	0	1
PRACTICALS									
7	22PYP01	Physics Laboratory	BSC	-	2	0	0	2	1
8	22CSP02	Data Structures Laboratory	ESC	-	4	0	0	4	2
9	22MEP01	Engineering Graphics Laboratory	ESC	-	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
10	22MAN04	Soft /Analytical Skills - II	MC	22MAN02	3	1	0	2	0
11	22MAN05	Yoga - II	MC	-	1	0	0	1	0
				TOTAL	**33**	**16**	**1**	**1**	**23**

SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22MYB06	Probability and Random Processes	BSC	-	4	3	1	0	4
2	22ECC05	Digital Logic Design	PCC	-	3	3	0	0	3
3	22ECC06	Signals and Systems	PCC	22MYB01, 22MYB04	3	3	0	0	3
4	22ECC07	Analog Electronics	PCC	22ECC04	3	3	0	0	3
5	22ECC08	Electromagnetic Waves	PCC	-	3	3	0	0	3
6	22ITC04	Algorithms	ESC	-	3	3	0	0	3
PRACTICALS									
7	22ECP02	Digital Logic Design Laboratory	PCC	-	4	0	0	4	2
8	22ECP03	Analog Electronics Laboratory	PCC	22ECC04	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
9	22MAN07	Soft / Analytical Skills - III	MC	-	5	3	0	2	0
10	22MAN09	Indian Constitution	MC	-	1	1	0	0	0
				TOTAL	**33**	**24**	**1**	**10**	**23**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22ITC06	Java Programming	ESC	-	3	3	0	0	3
2	22ECC09	Analog Circuit Design	PCC	22ECC04	3	3	0	0	3
3	22ECC10	Transmission Lines and RF Systems	PCC	22ECC08	3	3	0	0	3
4	22ECC11	Digital Signal Processing	PCC	22ECC06	5	3	0	2	4
5	22ECC12	Analog and Digital Communication	PCC	22ECC06	3	3	0	0	3
PRACTICALS									

6	22ITP04	Java Programming Laboratory	ESC	-	4	0	0	4	2
7	22ECP04	Analog Circuit Design Laboratory	PCC	22ECC04	4	0	0	4	2
8	22ECP05	Analog and Digital Communication Laboratory	PCC	22ECC06	4	0	0	4	2
MANDATORY NON CREDIT COURSES									
9	22MAN08	Soft/Analytical Skills - IV	MC	-	5	3	0	2	0
10	22GED01	Personality and Character Development	MC	-	1	0	0	1	0
				TOTAL	**35**	**20**	**0**	**15**	**22**

SEMESTER: V									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY & EMBEDDED COURSES									
1	22ECC13	Microprocessors and Microcontrollers	PCC	-	3	3	0	0	3
2	22ECC14	Data Communication Networks	PCC	-	3	3	0	0	3
3	22CYB06	Environmental Science and Sustainability	BSC	-	3	3	0	0	3
4	E1	Elective(PEC)	PEC	-	3	3	0	0	3
5	E2	Elective(PEC)	PEC	-	3	3	0	0	3
6	E3	Elective(PEC)	PEC	-	3	3	0	0	3
PRACTICALS									
7	22ECP06	Microprocessors and Microcontrollers Laboratory	PCC	-	4	0	0	4	2
8	22ECP07	Data Communication Networks Laboratory	PCC	-	4	0	0	2	2
MANDATORY NON CREDIT COURSES									
10	22MAN10	Soft/Analytical Skills – V	MC	-	3	1	0	2	0
11	22MAN11	Certification Course – I	MC	-	1	0	0	1	0
				TOTAL	**30**	**19**	**0**	**11**	**22**

22EYA01 - PROFESSIONAL COMMUNICATION - I

(Common to All Branches)

	L	T	P	C
	2	0	2	3

PREREQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To build essential English skills to address the challenges of communication in today's work environment.	1.1	The students will be able to apply knowledge of communication and language processes occur in various work environment.
2.0	To comprehend the various dimensions of communication by employing LSRW skills.	2.1	The students will be able to involve in diverse discourse forms utilizing LSRW skills.
3.0	To deploy students in contextual initiatives by assisting them in developing communication abilities.	3.1	The students will be able to participate actively in communication activities that enhance their creative skill.
4.0	To facilitate students in comprehending the intent, target audience and environments of various forms of communication.	4.1	The students will be able to associate with the target audience and contexts using varied types of communication.
5.0	To enhance coherence, cohesion, and proficiency in both verbal and nonverbal communication in the workplace environment.	5.1	The students will be able to convey the idea distinctly both in verbal and non verbal communication in work culture.

UNIT I –INTRODUCTORY SKILLS	**(6+6)**
Grammar – Parts of Speech – Verb (Auxiliaries – Primary & Modal, Main Verb) -**Listening** – Listening to Short Conversations or Monologues - Listening to Experiences – Listening to Descriptions- **Speaking** – Introducing Oneself – Exchanging Personal information - Talking about food and culture - **Reading**– Reading for Interrogation – Reading Newspaper, Advertisements and Interpreting - **Writing** - Seeking Permission for Industrial Visit & In-plant Training	
UNIT II – LANGUAGE ACUMEN	**(6+6)**
Grammar – Word Formation – Tenses (Present Tense) – Synonyms & Antonyms - **Listening** – Listening to Announcements – Listening to Interviews - Listening and Note-taking - **Speaking** – Talking about Holidays & Vacations – Narrating Unforgettable Anecdotes - **Reading** – Skimming – Scanning (Short Texts and Longer Passages) – Critical Reading - **Writing** – Instruction – Process Description	
UNIT III – COMMUNICATION ROOTERS	**(6+6)**
Grammar– Cause and Effect – Tenses (Past Tense) – Discourse Markers - **Listening** – Listening to Telephonic Conversations – Listening to Podcasts - **Speaking** – Talking about neoteric Technologies – Eliciting information to fill a form - **Reading** –Book Reading(Motivational) - Practicing Speed Reading (reading newspaper reports & biographies) - **Writing** – Checklist – Circular, Agenda & Minutes of the Meeting	
UNIT IV – DISCOURSE FORTE	**(6+6)**
Grammar – Tenses (Future Tense) –Yes/No & WH type questions – Negatives - **Listening** – Listening to TED/ Ink talks -**Speaking** – Participating in Short Conversations - **Reading** – Reading Comprehension (Multiple Choice / Short / Open Ended Questions) - **Writing** - E-Mail Writing	

UNIT V – LINGUISTIC COMPETENCIES	(6+6)
Grammar – Articles – Homophones & Homonyms – Single line Definition – Phrasal Verb - **Listening** – Intensive listening to fill in the gapped text - **Speaking** –Expressing opinions through Situations & Role play **Reading** – Cloze Texts - **Writing** – Paragraph Writing	
LIST OF SKILLS ASSESSED IN THE LABORATORY 1. Grammar 2. Listening Skills 3. Speaking Skills 4. Reading Skills 5. Writing Skills	
TOTAL (L:30 , P:30) = 60 PERIODS	

TEXT BOOK:

1. Shoba K N., Deepa Mary Francis, "English for Engineers and Technologists", Volume 1, 3rd Edition, Orient BlackSwan Pvt.Ltd, Telangana, 2022.

REFERENCES:

1. Koneru, Aruna, "English Language Skills", Tata McGraw Hill Education (India) Private Limited, Chennai, 2006.
2. Hewings M, "Advanced English Grammar", Cambridge University Press, Chennai, 2000.
3. Jack C Richards, Jonathan Hull and Susan Proctor, "Interchange", Cambridge University Press, New Delhi, 2015 (Reprint 2021).

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									3	3		2		1
2									3	3		2		1
3									3	3		2		1
4									3	3		2		1
5									3	3		2		1
CO (W.A)									**3**	**3**		**2**		**1**

22MYB01-CALCULUS AND LINEAR ALGEBRA

(Common to All Branches)

	L	T	P	C
	3	1	0	4

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To develop the use of matrix algebra techniques needed by engineers for practical applications.	**1.1**	The students will be able to apply the concept of orthogonal reduction to diagonalise a given matrix.
2.0	To use the techniques, skills and engineering tools necessary for engineering practice, with geometric concepts.	**2.1**	The students will be able to identify the geometric aspects of plane, straight line and sphere.
3.0	To improve the ability of the students in solving geometrical applications of differential calculus problems.	**3.1**	The students will be able to evaluate the radius of curvature, circle of curvature and centre of curvature for a given curve.
4.0	To learn the important role of mathematical concepts in engineering applications with the functions of several variables.	**4.1**	The students will be able to calculate the maxima and minima for a given function with several variables by finding the stationary points.
5.0	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.	**5.1**	The students will be able to evaluate the area and volume by double and triple integrals.

UNIT I - MATRICES	**(9+3)**
Characteristic Equation - Eigen values and Eigen vectors of a matrix - Cayley Hamilton Theorem (excluding proof) and its applications - Quadratic form-Reduction of a Quadratic form to canonical form by orthogonal transformation.	
UNIT II – ANALYTICAL GEOMETRY OF THREE DIMENSIONS	**(9+3)**
Equation of plane – Angle between two planes – Equation of straight lines - Coplanar lines –Equation of sphere – Orthogonal spheres.	
UNIT III - GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	**(9+3)**
Curvature – Curvature in Cartesian co-ordinates-Centre and Radius of curvature-Circle of curvature-Evolutes and Involutes.	
UNIT IV - FUNCTIONS OF SEVERAL VARIABLES	**(9+3)**
Partial derivatives - Euler's theorem on homogeneous function-Jacobian-Maxima and Minima of functions of two variables-Constrained Maxima and Minima by Lagrange's multiplier method.	
UNIT V - MULTIPLE INTEGRALS	**(9+3)**
Double integration in Cartesian Co-ordinates-Change of order of integration-Area as double integral- Triple integration in Cartesian Co-ordinates-Volume as triple integrals.	
TOTAL (L:45+T:15) :60 PERIODS	

LIST OF PROGRAMS USING MATLAB (Assignment/Online Test**)**:

1. Introduction to MATLAB
2. Matrix operations – Addition, Multiplication, Transpose and Inverse
3. Characteristic equation of a Matrix
4. Eigen values and Eigen vectors of Higher order Matrices.
5. Curve Tracing
6. Determining Maxima and Minima of a function of one variable.
7. Determining Maxima and Minima of a function of two variables.
8. Evaluating double integrals
9. Evaluating triple integrals
10. Finding area between two curves.

TEXT BOOKS:

1. Dr.B.S.Grewal, Higher Engineering mathematics, 42nd Edition, Khanna publications, 2012.
2. Erwin Kreyszig , Advanced Engineering mathematics , 9th Edition , John Wiley & sons ,2013
3. Veerarajan.T, Engineering Mathematics of semester I & II, 3rd Edition, Tata McGraw Hill. ,2016

REFERENCES:

1. N.P.Bali, Manish Goyal, "A text book of Engineering Mathematics -Sem-II", 6th Edition, Laxmi Publications, 2014.
2. Kandasamy.P, Thilagavathy.K, Gunavathy .K, "Engineering Mathematics for first year", 9th Rev.Ed, S.Chand & Co Ltd, 2013.
3. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Wiley India, 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2		1				1		2	2	2	1
2	3	2	2		1	1			1			2	2	
3	3	2	2		1							2	2	
4	3	2	2	1	1				1			2	2	
5	3	2	2	1	1				1		1	2	2	1
CO (W.A)	3	2	2	1	1	1			1		2	2	2	1

- **Ratified by Eleventh Academic Council**

22CYB04 ENGINEERING CHEMISTRY

(Common to ECE and EEE Branches)

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To recognize the basic concepts of electrochemistry and understand electrochemical processes.	**1.1**	The students will be able to evaluate fundamentals of electrochemistry, electrodes, cells and electrode potentials.
2.0	To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy sources and storage devices.	**2.1**	The students will be able to impart knowledge on renewable energy sources like nuclear, solar, wind energy and also on storage devices.
3.0	To make the students conversant with water treatment, boiler feed water techniques	**3.1**	The students will be able to identify the various water treatment techniques for domestic and industrial purpose.
4.0	To elucidate the types of polymers and concepts of surface chemistry.	**4.1**	The students will be able to use essential descriptions about polymer and surface chemistry.
5.0	To understand the concept of various analytical techniques.	**5.1**	The students will be able to impart knowledge on general principles and theory of analytical techniques.

UNIT I - ELECTROCHEMISTRY	**(9)**
Electrode potential - Nernst equation - derivation and problems - reference electrodes - standard hydrogen electrode -calomel electrode - electrochemical series - significance - Types of cell - electrolytic and electrochemical cells -reversible and irreversible cells - potentiometric titrations (redox) - conductometric titrations (acid-base).	
UNIT II - ENERGY SOURCES AND STORAGE DEVICES	**(9)**
Nuclear energy - nuclear fission - nuclear fusion - light water nuclear power plants - breeder reactor - solar energy conversion - solar cells - solar water heater - Recent developments in solar cell materials - wind energy - batteries - types of batteries - lead acid storage battery - lithium-ion battery, Electric vehicles - working principles.	
UNIT III - WATER TECHNOLOGY AND NANO MATERIALS	**(9)**
Municipal water treatment - disinfection methods (UV, ozonation, chlorination) - desalination of brackish water - reverse osmosis - boiler troubles (scale, sludge , priming, foaming and caustic embrittlement) - treatment of boiler feed water - internal treatment (carbonate, phosphate and calgon conditioning) - external treatment - demineralization process. Nanomaterials - synthesis (laser ablation, and chemical vapour deposition method) and applications of nanomaterials.	
UNIT IV - SURFACE CHEMISTRY AND POLYMERS	**(9)**
Surface chemistry - Adsorption - types - Differentiate between physical and chemical adsorption - Freundlich adsorption isotherm - Langmuir adsorption isotherm. Polymers - classification - addition - condensation - copolymerization – plastics - thermoplastics and thermosetting plastics - preparation, properties and uses of PVC and nylon- polymer processing - compression and injection moulding techniques.	

UNIT V - ANALYTICAL TECHNIQUES	(9)
Colorimetry - principles- estimation of Iron by colorimetry - UV-Visible spectroscopy- principles - instrumentation (block diagram only) - IR spectroscopy - principles - instrumentation (block diagram only) - Flame Photometry - principles - instrumentation (block diagram only) - estimation of sodium by flame photometry - Atomic absorption spectroscopy - principles - instrumentation (block diagram only) - estimation of nickel by atomic absorption spectroscopy.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Dr.Ravikrishnan, A," Engineering Chemistry I & Engineering Chemistry II , Sri Krishna Hitech Publishing chem. Co. Pvt Ltd., 13th ed., Chennai, 2020.
2. S.S. Dara," A text book of Engineering Chemistry", S.Chand & Co. Ltd. New Delhi, 2019.

REFERENCES:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Vol I &II, Dhanpat Rai Pub, Co, New Delhi 15th ed.,2018.
2. B.Sivasankar, "Engineering Chemistry", Tata McGraw- Hill Pub. Co. Ltd., New Delhi,2018

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		1			2	1		1			2		
2	3	1				2						2	1	1
3	3	1					1		1			2		
4	3	2	2			2	2		2			2		
5	3	2				2	2					2		
CO (W.A)	3	2	2			2	2		1			2	1	1

22CSC01 - PROBLEM SOLVING AND C PROGRAMMING

(Common to AI&DS, BME, CSE, CSE(CS), CSE(IOT), ECE, EEE and IT Branches)

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand problem solving, problem solving aspects, programming and to know about various program design tools.	**1.1**	The student will be able to identify the appropriate problem solving techniques to drive the solution for the given problem.
2.0	To learn basic structure and Control Statements in C programming.	**2.1**	The student will be able to implement the appropriate looping and control statements in C for developing applications.
3.0	To learn the manipulation of arrays and strings	**3.1**	The student will be able to develop programs on arrays of different dimensions of arrays and strings concepts.
4.0	To understand the concept of modular programming using user defined functions.	**4.1**	The student will be able to implement programs using user defined functions.
5.0	To acquaint with the use and benefits of Memory Allocation and file handling.	**5.1**	The student will be able to use dynamic memory allocation functions for assigning memory space during execution.

UNIT I -PROBLEM SOLVING AND C PROGRAMMING BASICS	**(9)**
General Problem Solving: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms **Basics of C Programming** : Introduction to C - Structure of C program - Programming Rules – Compilation – Errors - C Declarations: Tokens - keywords - identifiers - constants - data types - variable declaration and initialization - type conversion - constant and volatile variables - operators and expressions.	
UNIT II - DECISION CONTROL STATEMENTS	**(9)**
Managing Input and Output operations, Decision Control Statements: Decision control statements, Selection/conditional branching Statements: if, if-else, nested if, if-elif-else statements. Basic loop Structures/Iterative statements: while loop, for loop, selecting appropriate loop. Nested loops break and continue statements.	
UNIT III - ARRAYS AND STRINGS	**(9)**
Introduction to Array - Definition - Array initialization - Characteristics - One Dimensional Array - Array operations -Two dimensional arrays -Strings and String handling functions.	
UNIT IV - FUNCTIONS	**(9)**
Functions: Basics - definition - Elements of User defined Functions - return statement, Function types, Parameter Passing Techniques, Function returning more values - Passing Array to Functions - Recursion - Storage classes.	
UNIT V - POINTERS AND FILE MANAGEMENT	**(9)**
Pointer concepts - Pointers & Arrays, Structure concepts - Defining, Declaring, Accessing Member Variables, Structure within Structure - Union - File Management in C- Dynamic Memory Allocation	
TOTAL (L:45) :45 PERIODS	

TEXT BOOKS:

1. Ashok N. Kamthane, "Programming in C", 2nd ed., Pearson Education, 2013.
2. Sumitabha Das, "Computer Fundamentals and C Programming", 1st Edition, McGraw Hill, 2018.

REFERENCES:

1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st edition, ISBN10: 8131705625, ISBN-13: 978-8131705629.
2. Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition, India, ISBN-10: 9780132492645, ISBN-13: 978- 0132492645
3. YashavantKanetkar, "Let us C", 16th Edition, BPB Publications, 2018.
4. ReemaThareja., "Programming in C ", 2nd Edition, Oxford University Press, New Delhi, 2018.
5. Balagurusamy E., "Programming in ANSI C", 7th Edition, Mc Graw Hill Education, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	-	-	-	-	-	-	-	-	3	3	3
2	3	2	3	-	-	-	-	-	-	-	-	3	3	3
3	3	2	3	-	-	-	-	-	-	-	3	3	3	3
4	3	2	3	-	-	-	-	-	3	-	3	3	3	3
5	3	2	3	-	-	-	-	-	-	-	3	3	3	3
CO (W.A)	3	2	2.8	-	-	-	-	-	3	-	3	3	3	3

22ECC02 - BASICS OF ELECTRICAL AND INSTRUMENTATION ENGINEERING

(Common to ECE and BME Branches)

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make students to learn and understand the basics of Electrical Motor concepts.	**1.1**	The students will be able to Narrate Constructional details, principle of operation, performance and starters of D.C.Machines.
2.0	To enable the student to understand the basic concepts of electrical transformer	**2.1**	The students will be able to explicate the Constructional details, principle of operation and testing of Transformer.
3.0	To make the students to understand the concepts of induction motor and synchronous motor.	**3.1**	The students will be able to describe the Constructional details, principle of operation, starting, speed control of induction and synchronous Motors.
4.0	To make the students to understand basic concepts of measuring and electronics instruments.	**4.1**	The students will be able to Understand the principle of operation of basic measuring and electronics instruments.
5.0	To make the students to understand various types of transducers.	**5.1**	The students will be able to understand about operation of various types of transducers.

UNIT I - D.C. MACHINES	**(9)**
DC Generators: Constructional details – Principle of operation – EMF Equation – Methods of excitation – Applications – DC Motor: Constructional details – Principle of operation – Torque Equation – Applications – Types of starters.	
UNIT II - TRANSFORMERS	**(9)**
Single phase Transformers: Constructional details – Principle of operation – EMF Equation – Transformation ratio – Equivalent circuit – Efficiency and Voltage Regulation – Applications.	
UNIT III - INDUCTION MOTORS	**(9)**
Three phase Induction Motor: Construction – Types – Principle of operation – Applications – Single phase Induction Motor: Construction – Principle of operation – Starting methods – Applications.	
UNIT IV - MEASUREMENTS AND INSTRUMENTATION	**(9)**
Functional elements of an instrument – Standards and calibration – Measurement Errors - types of error – Moving coil meters – Moving iron meters – CRO – Digital voltmeter: successive Approximation type.	
UNIT V -TRANSDUCERS	**(9)**
Transducers: Basic Requirements – Classification – Resistive: Strain gauge – Resistance Thermometer – Thermistor – Inductive: LVDT – Piezoelectric – Thermocouples.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:
1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020. 2. A.K. Sawhney, Puneet Sawhney "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, New Delhi, 2015.
REFERENCES:
1. S. K, Bhattacharya, "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017. 2. R.K.Rajput, "Electronic Measurements and Instrumentation", S.Chand & company Ltd, 2015.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1	2	2	2	1	-	-	-	-	-	-	-
2	2	2	1	3	1	2	1	-	-	-	-	-	-	-
3	2	2	2	2	1	2	2	-	-	-	-	-	1	-
4	2	1	2	1	2	3	1	-	-	-	-	-	1	1
5	2	1	2	2	2	2	3	-	-	-	-	-	-	1
CO (W.A)	2	2	2	2	2	2	2	-	-	-	-	-	-	1

22CYP01 CHEMISTRY LABORATORY

(Common to AGRI, BME, CHEM, CIVIL, ECE, EEE and MECH Branches)

L	T	P	C
0	0	2	1

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To explain the origin of hardness, alkalinity, and chloride and dissolved oxygen in water.	1.1	The students will be able to acquire practical skills in the determination of water quality parameters through volumetric analysis
2.0	To determine the copper in brass in the given solution.	2.1	The students will be able to evaluate the amount of copper in the given analyze by titration method.
3.0	Enable the students to acquire knowledge of conductometric titrations and their calculations.	3.1	The students will be able to gain the knowledge about conductance of ions.
4.0	To perform a potentiometric titration and pH of an acidic solution of known Normality.	4.1	The students will be able to analyze and gain experimental skill about activity of hydrogen ions and measures the voltage
5.0	To know about pH of the solution and how to measure pH using pH meter.	5.1	The students will be able to utilize the fundamental laboratory techniques for analyses such as pH of acidic, basic and neutral solution.

LIST OF EXPERIMENTS

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of DO content of water sample by Winkler's method.
5. Estimation of copper in brass by EDTA.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of strength of given hydrochloric acid using pH meter.

Total (P:30) : 30 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1		1	1	1					1	1	1	
2	2	1		1		1	2				1	1		
3	2			1		1	2				1	1		
4	2			1	2	1	2				1	1	1	
5	2	2		1		1	2					1		
CO (W.A)	2	1	-	1	2	1	2	-	-	-	1	1	1	

- **Ratified by Eleventh Academic Council**

22CSP01 - PROBLEM SOLVING AND C PROGRAMMING LABORATORY

(Common to AI&DS, BME, CSE, CSE(CS), CSE(IOT), ECE, EEE and IT Branches)

L	T	P	C
0	0	4	2

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To study, analyze and understand logical structure of a computer program, and different construct to develop a program in 'C' language.	**1.1**	The student will be able to identify the appropriate programming construct to develop programs for all types of problems.
2.0	To study, analyze and implement the concepts of arrays and strings in C programming.	**2.1**	The student will be able to implement programs on arrays of different dimensions and string concepts.
3.0	To learn the importance user defined functions and pointers.	**3.1**	The student will be able to develop programs using user defined functions and pointers.
4.0	To gain knowledge in user defined data types and file handling functions in C programming.	**4.1**	The student will be able to design programs using user defined data types and various file handling functions.
5.0	To acquire skill in dynamic memory allocation.	**5.1**	The student will be able to use dynamic memory allocation functions for assigning memory space during execution.

C-Programming:

1. Draw the flowchart for the following using Raptor tool.
   a) Simple interest calculation
   b) Greatest among three numbers
   c) Find the sum of digits of a number
2. Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential and Selection structures).
3. Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (Iterative structures).
4. Programs for demonstrating one-dimensional and two-dimensional numeric array.
5. Programs to demonstrate modular programming concepts using functions.
6. Programs to implement various character and string operations with and without built-in library functions.
7. Programs to demonstrate the use of pointers.
8. Programs to illustrate the use of user-defined data types.
9. Programs to implement various file management.
10. Program Using Dynamic memory allocation functions.

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:
Hardware: • LAN System with 33 nodes (OR) Standalone PCs – 33 Nos. • Printers – 3 Nos. **Software:** • RAPTOR Tool • Compiler – C
TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	-	-	-	-	-	-	-	-	3	3	3
2	3	2	3	-	-	-	-	-	-	-	-	3	3	3
3	3	2	3	-	-	-	-	-	-	-	3	3	3	3
4	3	2	3	-	-	-	-	-	3	-	3	3	3	3
5	3	2	3	-	-	-	-	-	-	-	3	3	3	3
CO (W.A)	**3**	**2**	**2.8**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**	**3**	**3**

- **Ratified by Eleventh Academic Council**

22EYA02 - PROFESSIONAL COMMUNICATION - II

(Common to All Branches)

L	T	P	C
2	0	2	3

PREREQUISITE : 22EYA01

	Course Objectives		Course Outcomes
1.0	To familiarize the students with the basic structures of English and to train them to use these elements correctly in speaking and writing	**1.1**	The Students will be able to frame sentences both in written and spoken forms with accuracy and fluency.
2.0	To acquire proficiency in LSRW skills on par with the expectations of the industry.	**2.1**	The Students will be able to attain and enhance competence in the four modes of literacy: Listening, Speaking, Reading and Writing.
3.0	To enable students to adopt strategies for enhancing vocabulary, language and fluency and to deliver professional presentations.	**3.1**	The Students will be able to gain essential competency to express one's thoughts orally and in writing in a meaningful way.
4.0	To communicate effectively in an academic setting using the language skills as tools.	**4.1**	The students will be able to use linguistic structures to read and understand well-structured texts encountered in academic or social contexts.
5.0	To acquire necessary language skills to follow and comprehend discourse such as lectures, conversations, interviews, and discussions.	**5.1**	The Students will be able to perform various tasks, such as role plays, debates, group discussions apart from the use of correct spelling and punctuation

UNIT I – LANGUAGE RUDIMENTS	**(6+6)**
Grammar – Active and Passive Voice – Impersonal Passive Voice – Numerical Expressions - **Listening** – Listening for Specific Information and Match / Choose / Fill in the texts - **Speaking** – Describing a Person - Making Plans -**Reading** – Intensive Reading -**Writing** – Job Application with Resume.	
UNIT II - RHETORIC ENHANCERS	**(6+6)**
Grammar – Reported Speech – Infinitive and Gerund - **Listening** – Listening to Iconic Speeches and making notes - Listening news / documentaries - **Speaking** –Talking over Phone – Narrating Incidents - **Reading** – Extensive Reading (Motivational Books) - **Writing** – Recommendation	
UNIT III – TECHNICAL CORRESPONDENCE	**(6+6)**
Grammar – If Conditionals – Blended Words - **Listening** – Listening to business conversation on audio and video of Short Films, News, Biographies - **Speaking** – Synchronous communication and Asynchronous communication - Opportunities and threats in using digital platform- **Reading** - Finding key information in a given text - **Writing** –Netiquettes- Inviting Dignitaries - Accepting & Declining Invitation	

UNIT IV - CORPORATE COMMUNICATION	(6+6)
Grammar – Concord – Compound Words - **Listening** – Listening to Roles and Responsibilities in Corporate - Listening to technical videos - **Speaking** – Introduction to Technical Presentation - Story Telling - **Reading** – Reading and Understanding Technical Articles - **Writing** – Report Writing (Accident, Survey and feasibility)	
UNIT V - LANGUAGE BOOSTERS	**(6+6)**
Grammar - Idiomatic Expressions – Relative Clauses – Confusable words - **Listening** – Listening to different kinds of Interviews - Listening to Group Discussion - **Speaking** – Group Discussion - **Reading** – Reading and Interpreting Visual Materials - **Writing** – Analytical Paragraph Writing	

LIST OF SKILLS ASSESSED IN THE LABORATORY

1. Grammar.
2. Listening Skills.
3. Speaking Skills.
4. Reading Skills
5. Writing Skills

TOTAL (L:30 , P:30) = 60 PERIODS

TEXT BOOKS:

1. Sudharshana, N.P and Saveetha.C, "English for Technical Communication", Cambridge University Press, New Delhi, 2016 (Reprint 2017).

REFERENCES:

1. Rizvi, M Ashraf, "Effective Technical Communication", Second Edition, McGraw Hill Education India Pvt Ltd, 2017.
2. Rodney Huddleston, Geoffrey K. Pullum and Brett Reynolds, "A Student's Introduction to English Grammar", Second Edition, Cambridge University Press, New Delhi, 2022

WEB REFERENCE:

1. http://youtu.be/URtdGiutVew

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									3	3		2		1
2									3	3		2		1
3									3	3		2		1
4									3	3		2		1
5									3	3		2		1
CO (w.a)									**3**	**3**		**2**		**1**

22MYB04 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to BME and ECE Branches)

L	T	P	C
3	1	0	4

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To understand the concept of Fourier series and enhance the problem solving skill.	**1.1**	The students will be able to analysis the Fourier series problem
2.0	To develop the skills of the students in the areas of Transforms and Partial Differential Equations.	**2.1**	The students will be able to know the formation of partial differential equations.
3.0	To introduce the effective mathematical tools for the solutions of partial differential equations.	**3.1**	The students will be able to apply the partial differential equations to solve the various electrical and electronics application.
4.0	To acquaint the student with Fourier transform techniques used in wide variety of situations.	**4.1**	The students will be able to solve the problems using Fourier integral theorem and convolution theorem technique.
5.0	To develop Z-transform techniques for discrete time systems.	**5.1**	The students will be able to formulate Z - Transform techniques.

UNIT I – FOURIER SERIES	**(9+3)**
Dirichlet's condition – Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – RMS value – Harmonic Analysis.	
UNIT II – PARTIAL DIFFERENTIAL EQUATIONS	**(9+3)**
Formulation of partial differential equations by eliminating arbitrary constants and functions – Solution of standard types first order partial differential equations of the type f(p,q)=0,Clairaut's form – Lagrange's linear equations –Linear partial differential equation of second and higher order with constant coefficient of homogeneous types.	
UNIT III – APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	**(9+3)**
Classification of second order Quasi linear partial differential equations – Solution of one dimensional wave equation (Zero and non-zero velocity) – One dimensional heat equation (Temperature reduced to zero and non zero boundary conditions) – Steady state solution of two dimensional heat equation(Finite and infinite plate).	
UNIT IV –-FOURIER TRANSFORM	**(9+3)**
Fourier integral theorem(Statement only) – Fourier transform pair - Sine and Cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity(Excluding proof).	
UNIT V –Z-TRANSFORM AND DIFFERENCE EQUATIONS	**(9+3)**
Z-transforms – Elementary properties – Inverse Z-transform (Partial fraction method and Residue method) – Convolution theorem (Excluding proof) – formation of difference equations – Solution of difference equation using Z transform.	
TOTAL (L:45+T:15) :60 PERIODS	

TEXT BOOKS:

1. Veerajan.T,"Engineering Mathematics (for semester III), 3rd ed., Tata Mc Graw Hill, New Delhi.
2. Kandasamy.P, Thilagavathy.K, and Gunavathy. K., "Engineering Mathematics; Volume III", S.Chand & Coltd., 2008.
3. Grewal B.S,"Higher Engineering Mathematics", 42nd ed., Khanna publishers, New Delhi, 2012.

REFERENCES:

1. Goyal Manish and Bali. N.P,"A Text book of Engineering mathematics", 6th ed., Laxmi Publication (P) Ltd, New Delhi, 2012.
2. Kreyszig, Erwin,"Advanced Engineering Mathematics", 9th ed., Wiley Publications, New Delhi, 2006.
3. Singaravelu.A,"Transforms and Partial Differential Equations", Reprint Edition 2013, Meenakshi Publications, Tamilnadu.

WEB REFERENCES:

1. **https://youtu.be/B025y1UWkvI**
2. **https://youtu.be/IkAvgVUvYvY**
3. **https://youtu.be/RtVE2Gt-KQ4**
4. **https://youtube.com/playlist?list=PLs7oDAL8_ouKSagWiC_IwrEsRwvD2WJ73**

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	1					1	1		2		
2	3	2	1	1					1	1		2		
3	3	2	1	1					1	1		2		
4	3	2	1	1					1	1		2		
5	3	2	1	1					1	1		2		
CO (W.A)	3	2	1	1					1	1		2		

- **Ratified by Eleventh Academic Council**

22PYB03 - SOLID STATE PHYSICS

(Common to ECE, EEE & BME)

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To expose the concepts of semiconducting materials.	1.1	The students will be able to predict the importance of conducting materials in the communication field.
2.0	To gain fundamental concepts of dielectric materials in the engineering field.	2.1	The students will be able to acquire knowledge about the fundamentals of dielectric materials
3.0	To acquire the knowledge of magnetic and superconducting materials.	3.1	The students will be able to identify the importance of magnetic and superconducting materials.
4.0	To understand the knowledge of Fabrication process of integrated circuits**.**	4.1	The students will be able to update the knowledge of Integrated circuits and its fabrication.
5.0	To acquire the knowledge about recent development in advanced materials and nano technology.	5.1	The students will be able to explore the knowledge about recent development in advanced materials and nano materials.

UNIT I – SEMICONDUCTING MATERIALS	**(9)**
Introduction to semiconducting materials – Elemental and compound semiconductors – Intrinsic semiconductor – carrier concentration derivation – variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors (qualitative) – Hall effect – determination of Hall coefficient – Applications	
UNIT II – DIELECTRIC MATERIALS	**(9)**
Electrical susceptibility – dielectric constant – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferro electricity and applications.	
UNIT III – MAGNETIC AND SUPERCONDUCTING MATERIALS	**(9)**
Origin of magnetic moment – Bohr Magneton – Types of magnetic materials – Domain theory – Hysteresis – soft and hard magnetic materials – Ferrites – applications – Superconductivity – properties – types of superconductors – BCS theory of superconductivity (qualitative) – High Tc superconductors – Application of superconductors – Magnetic levitation.	
UNIT IV – FABRICATION PROCESS OF INTERGATED CIRCUITS	**(9)**
Bulk crystal growth – Epitaxial growth – masking and etching-diffusion of impurities-selective diffusion – Formation of PN junction – resistors – capacitors – inductors – isolation methods – metal semiconductor contact – Introduction to integrated circuit – monolithic and hybrid circuits – Thin film and Thick film technology – Definition of LSI, MSI, VLSI circuits.	

UNIT V – ADVANCED MATERIALS AND NANO TECHNOLOGY	(9)
Metallic glasses: preparation, properties and applications – Shape Memory Alloys (SMA): Characteristics, properties of NiTi alloy, application – Nano materials: Properties, Preparation – Pulsed laser deposition – chemical vapour deposition of nano particles and applications – Carbon nano tubes: fabrication – arc method – structure – properties and application.	
TOTAL (L: 45) = 45 PERIODS	

TEXT BOOKS:

1. M.N.Avadhanulu and P.G.Kshirsagar, "A text book of Engineering Physics", S. Chand and Company, New Delhi, 2019.
2. A.Marikani, "Materials Science", PHI Learning Private Limited, Eastern Economy Edition, 2017.
3. M.A.Wahab, "Solid State Physics", 3rd edition ,Narosa Publishing House Pvt.Ltd., 2016.

REFERENCES:

1. B.Rogers , J. Adams and S.Pennathur, "Nanotechnology : Understanding Small System" CRC Press, 2017.
2. Jacob Millman, Charistos C Halkilas, SatyabrataJit "Electronic Devices & Circuits", Tata McGraw Hill ,Education Private Limited, 2016, Third Edition.
3. Subrahmanyam N, Brijlal, "A Text Book Of Optics" S.Chand & Co. Ltd, New Delhi, 2019.

WEB LINKS:

1. https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf.
2. https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf.
3. https://rajeshvcet.home.blog/regulation-2021/ph3151-engineering-physics-study-materials/
4. https://zenodo.org/record/243407#.ZEgPZXZBzIU
5. https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf.
6. https://web.pdx.edu/~pmoeck/phy381/workbook%20nanoscience.pdf.

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	-	-	-	-	-	1	1	-	2	-	-
2	3	2	3	-	-	-	-	-	1	1	-	1	-	-
3	3	3	3	-	-	-	-	-	1	1	-	2	-	-
4	3	3	3	-	-	-	-	-	1	1	-	1	-	-
5	3	2	2	-	-	-	-	-	1	1	-	2	-	-
CO (w.a)	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	2.0	0.0	0.0

22CSC02 –DATA STRUCTURES USING C

(Common to 22AIC01, 22CSC02, 22CCC01, 22CIC01 and 22ITC01)

	L	T	P	C
	3	0	0	3

PREREQUISITE : 22CSC01

Course Objectives		Course Outcomes	
1.0	To learn the concept of pointers and strings	**1.1**	The student will be able to able to perform array and string operations using pointers
2.0	To be able to implement the abstract data type list as a linked list using the node and reference pattern.	**2.1**	The student will be able to able to manipulate different operations using linked list
3.0	To understand the Stack and Queue ADT	**3.1**	The student will be able to able to deploy different operations on stack and queue.
4.0	To gain knowledge on tree data structure.	**4.1**	The student will be able to determine the structure and operations on trees
5.0	To understand the various operations on graph	**5.1**	The student will be able to implement the various operations on graph

UNIT I - POINTERS USING ARRAYS AND STRINGS	**(9)**
Pointers : Introduction – Pointers and arrays– passing an array to a function– returning an array from function – NULL pointers –Array of pointers – Pointer-to-pointer – Dangling Pointer. Function pointers: calling a function using function pointer- Using pointer as a function argument	
UNIT II - LIST	**(9)**
Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT	
UNIT III - STACKS AND QUEUES	**(9)**
Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressionsInfix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues	
UNIT IV - TREE	**(9)**
Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap.	

UNIT V - GRAPHS	(9)
Definitions – Representation of Graphs – Types of Graph – Graph Traversal: Depth-First Search (DFS) – Breadth-First Search (BFS) – Topological Sort – Applications of DFS: Bi-connectivity – Euler Circuits – Finding Strongly Connected Components – Applications of BFS: Bipartite Graph.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Sumitabha Das, "Computer Fundamentals &C Programming", McGraw Hill Education(India) Private Limited, 1st Edition, 2018.
2. Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.

REFERENCES:

1. Yashavant Kanetkar, "Pointers in C", BPP Publications, 4th Edition, 2017.
2. PradipDey, Manas Ghosh, "Programming in C", Oxford Higher Education, 2nd Edition, 2016.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	2	1	-	-	2	-	2	3	3	3
2	3	3	2	2	2	2	-	-	1	-	2	3	3	3
3	2	3	2	2	2	2	-	-	2	-	2	3	3	3
4	3	3	2	2	2	1	-	-	1	-	2	3	3	3
5	3	3	2	2	2	1	-	-	2	-	2	3	3	3
CO (W.A)	2.8	3	2	2	2	1.4	-	-	1.6	-	2	3	3	3

- **Ratified by Eleventh Academic Council**

22ECC04 - ELECTRONIC DEVICES AND CIRCUITS

(Common to ECE and BME Branches)

	L	T	P	C
	3	0	2	4

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make students to examine the basics of Semiconductor Diodes and its characteristics.	**1.1**	The students will be able to examine Semiconductor Diodes and its characteristics.
2.0	To enable the student to analyze the characteristics of Bipolar Junction Transistor and FET.	**2.1**	The students will be able to analyze characteristics of BJT for various operations and FET.
3.0	To make the students to analyze the operation of Special semiconductor diodes.	**3.1**	The students will be able to analyze the operation of Special semiconductor diodes.
4.0	To make students to examine the basics of Electrical circuits.	**4.1**	The students will be able to apply the Ohm's law and Kirchhoff's law and investigates the behavior of electric circuits by analytical techniques.
5.0	To enable the student to Design simple network by exploring circuit theorems.	**5.1**	The students will be able to Design simple network by exploring circuit theorems.

UNIT I – PN DIODE AND BJT	**(9)**
Formation of PN junction – working principle – VI characteristics – PN diode currents – Switching Characteristics. NPN and PNP transistors – Current equations – Input and Output characteristics of CE, CB, CC Configurations.	
UNIT II – FET AND SPECIAL DIODES	**(9)**
JFET – Drain and Transfer Characteristics - MOSFET – Characteristics. Zener diode, Varactor diode, Tunnel diode, PIN diode, LDR	
UNIT III – BASICS OF CIRCUIT ANALYSIS	**(9)**
Ohms Law, Kirchhoff's Current Law, Kirchhoff's voltage law, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis. Delta-Wye Conversion	
UNIT IV - NETWORK THEOREMS FOR DC	**(9)**
Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Reciprocity theorem.	
UNIT V -NETWORK THEOREMS FOR AC	**(9)**
Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem-Reciprocity theorem	

LIST OF EXPERIMENTS :

1. Plot the Characteristics of PN Junction Diode and Zener Diode.
2. Plot the Input-Output characteristics of common Emitter and common Base configuration.
3. Plot FET Characteristics.
4. Verification of KVL and KCL
5. Verification of Thevenin and NortonsTheorem.
6. Verification of Superposition Theorem and Reciprocity Theorem.

TOTAL (L:45+P:30) : 75 PERIODS

TEXT BOOKS:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 2nd ed., Pearson Education, 2019.
2. Charles K. Alexander, Matthew N. O. Sadiku, "Fundamentals of Electric Circuits", 2nd ed, McGraw-hill Education, 2017

REFERENCES:

1. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGrawHill Third Edition, 2013
2. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008
3. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", 8th edition., Tata McGraw Hill publishers, New Delhi, 2013

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
2	3	3	2	1	-	-	-	-	-	-	-	1	-	1
3	1	2	1	-	-	1	1	-	-	-	1	2	-	1
4	3	3	2	2	-	-	-	-	-	-	-	-	2	-
5	3	3	2	2	-	1	-	-	-	-	1	2	2	1
CO (w.a)	**2.6**	**2.6**	**1.6**	**1.6**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**1.6**	**1.6**	**1**

22PYP01 - PHYSICS LABORATORY *(Common to All Branches)*					
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To provide the basic practical exposure to all the engineering and technological streams in the field of physics.	1.1	The students will be able to apply the concept of stress, strain and elastic limit for a given sample to find their properties		
2.0	To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory.	2.1	The students will be able to gain the basic knowledge about handling the laser light and Identify the basic parameters of an optical fiber		
3.0	To enable the students to correlate the theoretical principles with application oriented studies.	3.1	The students will be able to analyze the properties of matter with sound waves		
4.0	To introduce different experiments to test basic understanding of physics concepts applied in optics and electronics	4.1	The students will be able to recall the knowledge of properties of light through spectrometer grating and fiber optic cable		
5.0	To analyze the behavior and characteristics of solar cells and LED	5.1	The students will be able to acquire the knowledge in semiconducting devices such as solar cells and LED		

LIST OF EXPERIMENTS

1. Determination of Young's modulus by non-uniform bending method
2. Determination of (a) wavelength and (b) particle size using Laser.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of band gap of a semiconductor.
6. Determination of thickness of a thin wire – Air wedge method.
7. Determination of V-I characteristics of solar cell.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	-	-	-	-	-	-	1	-	2	1	-
2	3	3	2	-	-	-	-	-	-	-	-	1	1	-
3	3	3	2	-	-	-	-	-	1	-	-	1	-	-
4	3	2	3	-	-	-	-	-	-	-	-	2	-	-
5	3	2	2	-	-	-	-	-	-	1	-	1	-	-
CO (w.a)	**3.0**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**-**	**1.0**	**1.0**	**-**	**1.0**	**1.0**	**-**

- **Ratified by Eleventh Academic Council**

22CSP02 –DATA STRUCTURES LABORATORY

(Common to 22CSP02, 22AIP01, 22CCP01, 22CIP01 and 22ITP01)

L	T	P	C
0	0	4	2

PREREQUISITE :

	Course Objectives		Course Outcomes
1.0	To learn the concept of pointers	**1.1**	The students will be able to perform array operations using pointers
2.0	To learn the implementation of all types linked list with its different operations.	**2.1**	The students will be able to explore various operations on linked list.
3.0	To impart the basic stack and queue concepts and its applications.	**3.1**	The students will be able to work with stack and queue concepts.
4.0	To Explore the concepts of tree data structures	**4.1**	The students will be able to construct and manipulate various tree operations.
5.0	To understand the various operations on graph	**5.1**	The students will be able to deploy different operations on graphs.

LIST OF EXPERIMENTS:

1. Pointer using 1D, 2D array
2. Dynamic memory allocation
3. Implementation of singly linked list and its operations
4. Implementation of doubly linked list and its operations
5. Implementation of circular linked list and its operations
6. Implementation of Infix to postfix conversion using stack ADT
7. Implement the application for evaluating postfix expressions using array of stack ADT
8. Implementation of reversing a queue using stack
9. Binary Search Tree
10. AVL Tree
11. Priority Queues (Heaps)
12. Implementation of Graph Traversals(BFS, DFS)

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:

Hardware:

LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.

Software:

Compiler – C

TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
Cos	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	2	1	-	-	2	-	2	3	3	3
2	3	3	3	3	1	2	1	2	1	1	1	2	3	2
3	2	3	2	2	1	-	3	-	2	-	3	1	3	2
4	3	3	3	1	1	2	-	1	1	-	1	-	3	2
5	3	2	3	3	2	1	-	1	-	1	2	2	3	2
CO (W.A)	2.8	2.8	2.6	2.2	1.4	1.5	2	1.3	1.5	1	1.8	2	3	2.2

22MYB06 –PROBABILITY AND RANDOM PROCESSES *(Common to BME and ECE Branches)*					
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**
PRE REQUISITE :NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the concepts of probability, conditional probability and independence	**1.1**	The students will be able to understand the fundamental knowledge of the basic probability concepts.		
2.0	To obtain the distributions of functions of random variables.	**2.1**	The students will be able to well-found in knowledge of standard distributions which can describe real life phenomena		
3.0	To understand the classification of random processes.	**3.1**	The students will be able to acquire skills in handling situations involving more than one random variable and functions of random variables.		
4.0	To understand the concepts as strict stationary, wide sense stationary and Ergodic.	**4.1**	The students will be able to understand and characterize phenomena which evolve with respect to time in probabilistic manner.		
5.0	To understand the concepts of correlation function and power spectral density.	**5.1**	The students will be able to apply concept and properties of spectral density function and cross correlation functions.		

UNIT I – ONE DIMENSIONAL RANDOM VARIABLES	**(9+3)**
Probability: Random variable – Probability mass function – Probability density functions – Properties – Moments –Moment generating functions and their properties	
UNIT II-STANDARD DISTRIBUTIONS	**(9+3)**
Discrete distributions: Binomial, Poisson and Geometric distribution – Continuous distributions: Uniform, Exponential and Normal distribution and its properties.	
UNIT III –TWO DIMENSIONAL RANDOM VARIABLES	**(9+3)**
Joint distributions – Marginal distributions and conditional distribution – Covariance – correlation and Regression – Transformation of random variables – Central limit theorem (Excluding proof).	
UNIT IV–RANDOM PROCESSES	**(9+3)**
Definition and examples – first order, second order strictly stationary, wide-sense stationary and Ergodic process- Markov process – Binomial, Poisson processes.	
UNIT V – CORRELATION AND SPECTRAL DENSITIES	**(9+3)**
Auto correlation – Cross correlation – Properties –Power spectral density – Cross spectral density – Properties – Wiener – Khintchine relation (statement only) – Relationship between cross power spectrum and cross correlation function.	
TOTAL (L:45+T:15) :60 PERIODS	

TEXT BOOKS:

1. Veerarajan.T, "Probability, Statistics and Random Processes,"3rd ed.,NewDelhi,Tata McGraw-Hill,2008
2. Venkatarama Krishnan, "Probability and Random Process,"2nd Edition,John Wiley & Sons , New Jersey,2016
3. Scott L. Miller and Donald Childers, "Probability and Random Processes with applications to Signal Processing and communications," Elsevier, 2012.

REFERENCES:

1. GubnerA.John, "Probability and Random Processes for Electrical and Computer Engineers", Cambridge University press, Newyork, 2006.
2. Charles W.Therrien, Murali Tummala, "Probability and random process for electrical and computer Engineers", CRC Press, Newyork, 2012.
3. Singaravelu.A, Sivasubramanian, Ramaa, "Probability, Statistics and Random Processes," 2nd ed., MeenakshiPublication, Chennai, 2003.

WEB REFERENCES:

1. https://youtu.be/82Ad1orN-NA
2. https://youtube.com/playlist?list=PLOgMKE5DWMGLZcBxYJBFAikdhAaAXJ1_U

Mapping of COs with POs / PSOs

Cos	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2		1					1	1		2		
2	3	2	2	1					1	1		2		
3	3	2	2						1	1		2		
4	2	2	2		1				1	1		2		
5	2	2			1				1	1		2		
CO (W.A)	3	2	2	1	1				1	1		2		

22ECC05 - DIGITAL LOGIC DESIGN				
	L	T	P	C
	3	0	0	3
PRE REQUISITE : Nil				

Course Objectives		Course Outcomes	
1.0	To make the students to understand the principles and theorems in Digital logic circuits	**1.1**	The Students will be able to apply the Boolean laws and theorems can able to minimize the Boolean expressions
2.0	To enable the student to design and modeling of combinational circuits using Verilog.	**2.1**	The Students will be able to Design simple combinational logic circuits in hardware and simulation using Verilog.
3.0	To make the students to implement the synchronous sequential logic circuits.	**3.1**	The Students will be able to Design synchronous sequential logic circuits in hardware and simulation using Verilog.
4.0	To make the students to design the asynchronous sequential logic circuits.	**4.1**	The Students will be able to Design asynchronous sequential logic circuits.
5.0	To enable the student to design memories and programmable logics.	**5.1**	The Students will be able to construct Programmable arrays and memory logics.

UNIT I - DIGITAL FUNDAMENTALS	**(9)**
Number Systems – Decimal, Binary, Octal, Hexadecimal, Complements -1's and 2's complements, Codes – Binary, BCD, Excess-3, Gray code, Boolean Algebra-Boolean rule, Laws, theorems, Boolean Functions-Sum of products (SOP) and product of sums (POS, Karnaugh map (K-Map) Minimization (upto 4 variables)- NAND and NOR implementation.	
UNIT II - COMBINATIONAL LOGIC DESIGN	**(9)**
Design of Half and Full Adders, Half and Full Subtractor, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity generator and checker, Hardware Description Language (HDL) - Modeling of Combinational circuits using Verilog.	
UNIT III - SYNCHRONOUS SEQUENTIAL LOGIC DESIGN	**(9)**
Flip flops – SR, JK, T, D, Master/Slave FF – Operation and Excitation tables, Design of Counters- Ripple Counters, Ring Counters, Johnson's Counter,Modulo-N counters,Shift registers- SISO,SIPO,PIPO,PISO. Modeling of Sequential Circuits using Verilog.	
UNIT IV - ASYNCHRONOUS SEQUENTIAL LOGIC DESIGN	**(9)**
Analysis and Design Procedure - State table and State diagrams, State Reduction Techniques. Cycles and races, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.	
UNIT V - MEMORY AND PROGRAMMABLE LOGIC FAMILIES	**(9)**
Basic memory structure – ROM -PROM – EPROM – EEPROM , RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL	
	TOTAL (L:45) : 45 PERIODS

TEXT BOOKS:

1. M. Morris Mano & Michael D.Ciletti, "Digital Design with an Introduction to the Verilog HDL, 5th Edition, Prentice Hall of India Pvt.Ltd. 2015.
2. Dr. Sanjay Sharma, "Digital Electronics and Logic Design" 4th Edition., S.K.Kataria & Sons, 2017

REFERENCES:

1. Stephan D.Brown & Zvonko G.Vranesic, "Fundamentals of Digital Logic with VHDL Design, 2'nd Edition, Tata Mc Graw – Hill, 2003.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis,"2'nd Edition., Prentice Hall, 2009.
3. Thomas L. Floyd & R P Jain, "Digital Fundamentals," 10th Edition., PHI, 2011.
4. Ronald J Tocci & Neal S. Widmer, "Digital Systems, Principles and Applications," 10th Edition., Pearson education, 2011.
5. Frank Vahid, "Digital Design with RTL Design, Verilog and VHDL," 10'th Edition, John Wiley and Sons, 2010

Mapping of COs with POs / PSOs

COs	POs												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	2	3	-	-	1	-	-	3	3	3	2	3	2
2	3	2	1	2	3	-	-	1	1	-	3	3	3	2	3	2
3	-	-	1	-	-	1	3	1	1	3	3	3	3	3	3	2
4	3	3	2	2	3	2	3	1	2	3	3	3	3	3	3	2
5	3	3	-	2	3	-	-	1	2	3	3	3	3	3	3	2
CO (w.a)	**3**	**2.5**	**1.3**	**2**	**3**	**1.5**	**3**	**1**	**1.5**	**3**	**3**	**3**	**3**	**2.6**	**3**	**2**

22ECC06 – SIGNALS AND SYSTEMS

(Common to ECE & BME Branches)

L	T	P	C
3	0	0	3

PRE REQUISITE : 22MYB01, 22MYB04

Course Objectives		Course Outcomes	
1.0	To understand the basic properties of signal & systems and its various methods of classification.	1.1	The students will be able to incorporate vaious operations on continuous time & discrete time signals.
2.0	To learn the characterization of continuous time domain LTI systems.	2.1	The students will be able to analyze the characterization of continuous time domain LTI systems.
3.0	To recognize various transforms and their properties applied in continuous time signal analysis.	3.1	The students will be able to apply Laplace transform, Fourier transform and Fourier series in continuous time signal analysis.
4.0	To learn the characterization of discrete time domain LTI systems.	4.1	The students will be able to identify the characterization of discrete time domain LTI systems.
5.0	To recognize various transforms and their properties applied in discrete time signal analysis.	5.1	The students will be able to design discrete time LTI system using DTFT and Z transform.

UNIT I - CLASSIFICATION OF SIGNALS AND SYSTEMS	**(9)**
Standard Signals: Unit impulse, unit step, unit ramp, exponential, and sinusoidal signals, Classification of Continuous and discrete time signals, Types of signals: power, energy, periodic, even and odd, Basic Operations on Signals, Basic System Properties: Linearity, Time Invariant, causality, stability and invertibility, LTI.	
UNIT II - TIME DOMAIN CHARACTERISATION OF CONTINUOUS TIME LTI SYSTEM	**(9)**
Classification of systems - CT systems and DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable - Convolution Integral, Properties of continuous time LTI system-Causality, stability, Causal continuous time LTI system described by differential equations	
UNIT III- FREQUENCY DOMAIN REPRESENTATION IN CT SIGNALS	**(9)**
Fourier series representation- exponential, Fourier transform of continuous time aperiodic signals and periodic signals, properties of continuous time Fourier transform, Laplace transform, Region of Convergence, Inverse Laplace transform.	
UNIT IV – TIME DOMAIN CHARACTERISATION OF DISCRETE TIME LTI SYSTEM	**(9)**
Sampling theorem (Low Pass) – Reconstruction of a Signal from its samples, aliasing, Convolution sum, properties of discrete time LTI system, Causal discrete time LTI system described by difference equations.	
UNIT V- FREQUENCY DOMAIN REPRESENTATION IN DT SIGNALS	**(9)**
Fourier Transform of discrete time signals(DTFT) - Properties of DTFT-Z Transform, Inverse Z transform – Long division – partial fraction, ROC, Properties of Z Transform: Linearity, time shifting, change of scale, Z-domain differentiation, differencing, accumulation, convolution in discrete time, initial and final value theorems.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Simon S. Haykin and Barry Van Veen, "Signals and Systems,"2 Nd Edition. Wiley India, 2008(Reprint).

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	1	2	2	2	1	-	-	-	-	-	-	-
2	2	2	1	3	2	3	1	-	-	-	-	-	-	-
3	3	2	3	2	1	2	2	-	-	-	-	-	1	-
4	3	1	2	1	2	2	1	-	-	-	-	-	1	1
5	2	2	2	2	1	2	3	-	-	-	-	-	-	1
CO (W.A)	2	2	2	2	1	2	2	-	-	-	-	-	1	1

22ECC07 - ANALOG ELECTRONICS					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : 22ECC04					
Course Objectives		**Course Outcomes**			
1.0	To understand the different biasing techniques of amplifier.	**1.1**	The Students able to understand and design amplifier biasing circuit for BJT and FET.		
2.0	To study about small signal analysis of amplifiers.	**2.1**	The Students will be able to analyze various parameters of an amplifier using h model.		
3.0	To study about frequency response of amplifiers and different types of power amplifiers.	**3.1**	The Students will be able to draw the frequency response of single stage and multi-stage amplifiers and calculate the efficiency of different power amplifiers.		
4.0	To get awareness about the analysis of feedback amplifiers and tuned amplifiers.	**4.1**	The students will be able to analyze various parameters of feedback amplifiers and able to explain the working of differnt tuned amplifiers.		
5.0	To obtain knowledge about oscillators design and multivibrators.	**5.1**	The students will be able to design oscillators, multivibrators and Schmitt Trigger circuits.		

UNIT I - TRANSISTOR BIAS STABILITY	**(9)**
BJT – Need for biasing – Stability factor - Load line and quiescent point. - Different types of biasing circuits – Method of stabilizing the Q point - Bias compensation – Diode, Thermister and Sensistor compensations – Biasing of FET.	
UNIT II - SMALL SIGNAL AMPLIFIERS	**(9)**
Introduction –Analysis of transistor amplifier circuit using h parameters- Simplified CB, CE & CC - Darlington connection for high input impedance, BJT Differential Amplifiers.	
UNIT III - FREQUENCY RESPONSE OF AMPLIFIERS AND POWER AMPLIFIERS	**(9)**
Frequency response of amplifiers: cutoff frequencies and bandwidth –Multistage amplifiers: coupling methods-CE-CC amplifier- frequency response of multi stage amplifiers. Classification of amplifiers; Class A, Transformer coupled Class A audio amplifier - Class B amplifier - Push-Pull Class B amplifier – Distortion in Power Amplifiers.	
UNIT IV - FEEDBACK AMPLIFIERS AND TUNED AMPLIFIERS	**(9)**
Feedback amplifiers: Effect of negative feedback on amplifiers, Nyquist criterion. Tuned Amplifier: single and double tuned amplifiers- Stagger tuned amplifiers. Stability of tuned amplifiers - Neutralization - Hazeltine neutralization method.	
UNIT V- OSCILLATORS AND MULTIVIBRATORS	**(9)**
Barkhausen Criterion - Analysis of LC oscillators: Hartley – Colpitts oscillator, RC oscillators: RC Phase shift oscillator - Wien bridge oscillator. Multivibrators - Astable multivibrator - Monostable multivibrator - Bistable multivibrator - Schmitt trigger	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, Pearson Education / PHI, 2007.

REFERENCES:

1. Millman J and Halkias .C, Integrated Electronics, 4th Edition, Tata McGraw Hill, 2015.
2. S. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Private limited, Fifth Edition 2022.
3. David A. Bell, Electronic Devices & Circuits, Oxford Higher Education Press, 5th Edition, 2010.
4. Muhammad H. Rashid, Microelectronic Circuits: Analysis and Design, 2nd Edition, Cengage Learning, 2011.
5. Donald .A. Neamen, Electronic Circuit Analysis and Design –3rd edition, TMH, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3				3			2			3	2	1
2	3	3				2						3	1	2
3	2	2				3							3	
4	3			2							3	3	2	2
5			2						3		3		1	1
CO (W.A)	**3**	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**2**	**-**	**3**	**3**	**2**	**1**

22ECC08 - ELECTRO MAGNETIC FIELDS					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : 22PYB03					

Course Objectives		Course Outcomes	
1.0	To make students to learn and understand the basics of Vector Calculus and Gauss law.	**1.1**	The Students can apply vector calculus to static electric and magnetic fields in different engineering situations.
2.0	To enable the student to evaluate the electric field due to charge distribution and boundary conditions	**2.1**	The Students will be able to analyze fields a potentials due to static changes
3.0	To enable the student to evaluate the magnetic field due to line charge and boundary conditions.	**3.1**	The Students will be able to evaluate static magnetic fields
4.0	To make the students to analyze about time varying electric and magnetic fields.	**4.1**	The students can understand the relation between the fields under time varying situations
5.0	To make the students to know about the electromagnetic wave equation and wave polarization	**5.1**	The students can acquire knowledge about electromagnetic waves and its polarization

UNIT I - VECTOR ANALYSIS, DIVERGENCE, CURL	**(9)**
Scalar and Vector analysis - Vector algebra - Coordinate systems: Cartesian coordinate system, cylindrical coordinate system and spherical coordinate system - Divergence, gradient and curl – Divergence and Stokes theorems- Coulomb's Law - Gauss Law & its applications	
UNIT II - STATIC ELECTRIC FIELDS	**(9)**
Electric field intensity – Continuous Charge Distribution, Electric Field due to charges distributed uniformly on an infinite, finite line and circular disc. Relationship between potential and electric field - Electric flux density. Current and Current Density – Boundary conditions for electric fields between free space and conductors, and between dielectrics	
UNIT III - STATIC MAGNETIC FIELD AND MAGNETIC MATERIALS	**(9)**
Biot-Savart Law in vector form – Magnetic Field intensity due to a finite and infinite wire carrying a current I – Magnetic field intensity on the axis of a circular and rectangular loop carrying a current I – Ampere's circuital law and simple applications-Lorentz Force Equation, Magnetic flux density, Magnetic boundary conditions. Inductance – Inductance of loops and solenoids –Mutual inductance – simple examples	
UNIT IV - TIME VARYING ELECTRIC AND MAGNETIC FIELDS	**(9)**
Faraday's law –Conduction and Displacement current density –Maxwell's four equations in integral form and differential form- Maxwell's equation in Phasor form -Poynting Vector and the flow of power – Power flow in a co-axial cable	
UNIT V - ELECTROMAGNETIC WAVES	**(9)**
Wave equations for conducting medium and in free space - Wave equations in Phasor form –Reflection of plane waves by a perfect dielectric at normal incidence - wave polarizations-Introduction to EM Shielding Case Study: Biological Effects of Electromagnetic Waves.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:
1. William H. Hayt, Jr and John A. Buck, "Engineering Electromagnetics", 8th Edition, Tata McGraw Hill Publishing Company, NewDelhi, 2012
REFERENCES:
1. Matthew N.O. Sadiku,S.V.Kulkarani, "Principles of Electromagnetics", 6th Edition, Oxford University Press, 2015. 2. Edward .C.Jordan. and Keith.G.Balmain "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	-	-	-		2	1	-	2	-	2	2	-
2	3	3	-	-	-	2	2	1	-	2	-	2	2	-
3	3	3	-	-		2	2	1	-	2	-	2	2	-
4	3	3	2	2	2	-	1	-	-	-	-	2	2	-
5	3	3	2	2	2	-	2	1	-	-	2	2	3	-
CO (W.A)	**3**	**3**	**2**	**2**	**2**	**2**	**1.8**	**1**	**-**	**2**	**2**	**2**	**2.2**	**-**

22ECP03 - ANALOG ELECTRONICS LABORATORY

	L	T	P	C
	0	0	4	2

PRE REQUISITE : 22ECC04

Course Objectives		Course Outcomes	
1.0	To design and construct different amplifiers biasing circuits.	**1.1**	The Students can be able to design, construct and draw the frequency response of amplifier biasing and Darlington circuits.
2.0	To gain design knowledge of negative feedback amplifiers.	**2.1**	The Students can be able to design and analyze the frequency response Power amplifiers, Negative feedback amplifiers and Tuned Amplifiers.
3.0	To learn about designing of various types of oscillators.	**3.1**	The Students will be able to design different oscillator circuits and observe their output waveform
4.0	To construct and analysis the different power amplifier	**4.1**	The Students will be able to design different Multivibrator circuits and observe their output waveform
5.0	To understand working multivibrators and wave shapers.	**5.1**	The students will be able to experiment the multivibrator and wave shapers.

LIST OF EXPERIMENTS:

1. Design and Construct BJT CE amplifier using Biasing Techniques (Fixed bias and Voltage follower Bias).
2. Construct Darlington Amplifier using BJT and measure its bandwidth.
3. Design and implementation of Class B Power Amplifier.
4. Design and implementation of Negative feedback amplifier (Current Series and Voltage Series).
5. Design and implementation of Single tuned amplifier.
6. Design and implementation of RC phase shift oscillator.
7. Design and implementation of Hartely oscillator.
8. Design and implementation of Astable and Monostable multivibrators.
9. Simulation of Class A amplifiers using PSPICE.
10. Simulation of Astable Multivibrator using PSPICE.
11. Simulation of Schmitt Trigger using PSPICE.

TOTAL (P: 60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	2		2	3			2			2	1
2	3	3	2	2		2	3			3			1	2
3	3	3	3	3		3	2			2			3	
4	3		2	2			3						2	2
5							3						1	1
CO (W.A)	**3**	**3**	**1.8**	**1.8**	**-**	**1.4**	**3**	**-**	**-**	**1.4**	**-**	**-**	**1.8**	**1.2**

22ITC06 - JAVA PROGRAMMING *(Common to 22AIC04 ,22CSC07, 22CCC06 and 22CIC06)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : Nil					

Course Objectives		**Course Outcomes**	
1.0	To understand Object oriented programming concepts and characteristics of Java	**1.1**	The students will be able to develop Java programs using OOP principles
2.0	To know the principles of Inheritance, abstraction and interfaces	**2.1**	The students will be able to develop Java programs with the concepts of inheritance
3.0	To define exceptions and use I/O streams	**3.1**	The students will be able to construct applications with exception handling.
4.0	To understand threads concepts	**4.1**	The students will be able to develop Java applications using threads
5.0	To design and build simple GUI programs using AWT and Swings.	**5.1**	The students will be able to develop interactive Java applications using GUI components.

UNIT I - INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	**(9)**
Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Strings, Packages - JavaDoc comments.	
UNIT II - INHERITANCE AND INTERFACES	**(9)**
Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods-Keywords: Static-final-this- final methods and classes – Method overloading-Method overriding-Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces	
UNIT – III EXCEPTION HANDLING AND I/O	**(9)**
Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing File	
UNIT – IV –THREADS	**(9)**
Java Thread Model – Main Thread – Creating a Thread – Creating Multiple Threads — Thread Priorities – Synchronization – Inter thread Communication – Suspending, Resuming, and Stopping Threads – Using Multithreading.	
UNIT – V EVENT DRIVEN PROGRAMMING	**(9)**
Graphics programming - Frame – Components Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.	
	TOTAL (L:45) : 45 PERIODS

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019.
2. Herbert Schildt, "Introducing Java FX 8 Programming", 1st Edition, McGraw Hill Education, New Delhi, 2015.

REFERENCE:

1. Cay. S. Horstmann, Gary Cornell, "Core Java-JAVA Fundamentals", Prentice Hall, 10th ed., 2016.
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.3. SCJP Sun Certified Programmer for Java 6 Study Guide. 6th edition, McGrawHill.

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1		1				1			1	2	1
2	3	1	1		1				1			1	1	2
3	3	1	1		1				2			1	2	1
4	3	2	1		1				2			2	1	1
5	3	2	2	2	1				3	1	3		1	1
CO (W.A)	**3.0**	**1.6**	**1.2**	**2.0**	**1.0**	**-**	**-**	**-**	**1.8**	**1.0**	**3.0**	**1.2**	**1.4**	**1.2**

22ECC09 - ANALOG CIRCUIT DESIGN

L	T	P	C
3	0	0	3

PRE REQUISITE : 22ECC04

	Course Objectives		Course Outcomes
1.0	To make the students to understand the circuit configurations for Linear Integrated Circuits.	1.1	The Students will able to understand basic concepts of Linear IC's.
2.0	To enable the student to design the basic applications of an op-amp.	2.1	The Students will be able to design all Linear and Non linear op-amp configurations.
3.0	To enable the student to design analog multiplier, PLLs and their applications.	3.1	The Students will be able to Design simple analog multiplier circuits and PLL applications
4.0	To make the students to design A to D and D to A converters.	4.1	The Students will be able to Design A to D and D to A converters.
5.0	To make the students to design the simple circuits using timers.	5.1	The Students will be able to Design simple analog circuits using op-amp.

UNIT I - CIRCUIT CONFIGURATION FOR LINEAR ICS	**(9)**
Introduction-Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Ideal operational amplifier, General operational amplifier stages, IC 741 Op-Amp, slew rate, CMRR, Open and closed loop configurations.	
UNIT II - APPLICATIONS OF OPERATIONAL AMPLIFIERS	**(9)**
Sign Changer, Scale Changer, Voltage Follower, V-to-I and I-to-V converters, Summing amplifier, Differential Amplifier, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Precision Rectifier, Schmitt trigger, Low-pass, high-pass and band-pass filters.	
UNIT III - ANALOG MULTIPLIER AND PLL	**(9)**
Analog Multiplier- Applications- Squarer and frequency doubler, Gilbert Multiplier cell - Variable trans conductance technique, Operation of the basic PLL, Capture range, Lock in range and pull in time, Application of PLL for AM detection, FM detection, FSK modulation and demodulation.	
UNIT IV - DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS	**(9)**
Introduction- D/A converter - specifications -Binary weighted resistor type, R-2R Ladder type, High speed sample-and-hold circuits, A/D Converters -specifications - Flash type - Successive Approximation type - Single Slope type - Dual Slope type.	
UNIT V -WAVEFORM GENERATORS AND SPECIAL FUNCTION IC's	**(9)**
Sine-wave generators, and Triangular wave generator, Saw-tooth wave generator, CL8038 function generator, Timer IC 555- Astable and Monostable operation, IC Voltage regulators - Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator -Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

2. Robert F. Coughlln and Driscoll, "Operation amplifiers and Linear Integrated Circuits", 6th ed., Pearson Education.2009.
3. Serglo Franco, "Design with Operational Ampliifers and Analog Integrated Circuits", 3rd Edition, TMH, 2007.

REFERENCES:

3. S.Saliahanan and V.S.Kanchana Bhaaskaran, "Linear Integrated Circuits", Tata McGraw Hill (2008).
4. P.R. Gray and R.G.Meyer, "Ananlysis and Design of Analog Integrated Circuit", John Willey, 2009.
5. D.Roy Choundhury and Shail B.Jain, "Linear Integrated Circuits", New Age International (P) Limited, 2011.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	1	2	2	2	1	-	-	-	-	-	-	-
2	2	2	1	3	1	3	1	-	-	-	-	-	-	-
3	2	2	3	2	1	2	2	-	-	-	-	-	1	-
4	3	1	2	1	2	2	1	-	-	-	-	-	1	1
5	2	2	2	2	2	2	3	-	-	-	-	-	-	1
CO (W.A)	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

22ECC10 - TRANSMISSION LINES AND RF SYSTEMS

L	T	P	C
3	0	0	3

PRE REQUISITE : 22ECC08

	Course Objectives		Course Outcomes
1.0	Introduce various types of transmission lines and analyze the lumped circuit model of a transmission line and their characteristics	1.1	The students will be able to analyze the transmission line along with its parameters.
2.0	To find SWR, Reflection Coefficient and impedance matching using Smith Chart.	2.1	The students will be able to measure VSWR and impedance using smith chart in single stub and double stub matching
3.0	To investigate the propagation of electromagnetic waves in Parallel plane waveguides.	3.1	The students will be able to compute the characteristics of guided waves between the parallel planes
4.0	To investigate the propagation of electromagnetic waves in rectangular and circular waveguides.	4.1	The students will be able to evaluate the characteristics of rectangular and circular waveguides
5.0	To illustrate about the basic RF components	5.1	The students will be able to use RF components for design Microwave circuits.

UNIT I - TRANSMISSION LINE THEORY (9)

Line Parameters, The transmission line – general solution, Physical significance of the equation, Wavelength and velocity of wave propagation, Waveform distortion, The distortion less line, the telephone cable, Loading of Transmission Line, Line not terminated in Z0- Reflection coefficient, Open circuit and short circuit line, Reflection factor and Reflection loss, Insertion Loss.

UNIT II - IMPEDANCE MATCHING (9)

Standing waves and standing wave ratio, Impedance matching- Half wavelength and Quarter wave transformer, single stub matching and Double stub matching. Smith chart, Applications - Measurement of VSWR, impedance, single stub and double stub using smith chart.

UNIT III - GUIDED WAVES (9)

Wave between the parallel planes, Transmission of TM waves between Parallel planes – Transmission of TE waves between Parallel planes. Transmission of TEM waves between Parallel planes –Velocities of the waves. Characteristic impedance of parallel plane.

UNIT IV - RECTANGULAR AND CIRCULAR WAVEGUIDES (9)

Applications of Maxwell's equations to the rectangular waveguide, TM waves in Rectangular waveguide, TE waves in Rectangular waveguide, Dominant mode in Rectangular waveguide - TM waves in Circular waveguide, TE waves in Circular waveguide , Dominant mode in Circular waveguide

UNIT V - RF COMPONENTS (9)

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.

TOTAL (L:45) : 45 PERIODS

TEXT BOOKS:

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015.
2. Mathew M. Radmanesh, "Radio Frequency &Microwave Electronics", Pearson Education Asia, Second Edition, 2002.

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko," RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition, 2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2004.
3. E.C.Jordan and K.G. Balmain, –Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006.
4. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	1			3	2		1			3	
2	3	2	1	1	3			2		1			2	
3	3	2	1	1			2	2		1			1	
4	3	2	1	1			2	1		1			1	
5	3	2	1	1	1			1		1			2	
CO (W.A)	**3**	**2**	**1**	**1**	**2**		**2.3**	**1.6**		**1**			**1.8**	

22ECC11 - DIGITAL SIGNAL PROCESSING				
	L	T	P	C
	3	0	2	4
PRE REQUISITE : 22ECC06				

Course Objectives		Course Outcomes	
1.0	To learn discrete Fourier transforms and Fast Fourier Transform and its properties.	**1.1**	The students will be able to apply DFT and FFT for the analysis of discrete signals & systems
2.0	To know the characteristics of FIR filters learn the design of finite impulse response filters for filtering undesired signals.	**2.1**	The students will be able to design and implement digital FIR filters.
3.0	To know the characteristics of IIR filters learn the design of infinite impulse response filters for filtering undesired signals.	**3.1**	The students will be able to design and implement digital IIR filters.
4.0	To understand Finite word length effects.	**4.1**	The students will be able to characterize Finite Word length effect on filters.
5.0	To understand the fundamental concepts of multi rate signal processing and its applications	**5.1**	The students will be able to apply in real time applications.

UNIT I - FAST FOURIER TRANSFORMS	**(9)**
Introduction to DFT and IDFT, Properties of DFT, FFT Algorithm-Radix-2 - Decimation in Time (DIT)-Decimation in Frequency (DIF)Fast Convolution-Overlap Save method-Overlap Add Method.	
UNIT II – DIGITAL IIR FILTERS	**(9)**
Review of design techniques for analog low pass filter (Butterworth and Chebyshev type-1), Frequency transformation in Analogue domain, IIR filter Design: Bilinear and Impulse Invariant Techniques, Realization structures for IIR filters.	
UNIT III - DIGITAL FIR FILTERS	**(9)**
Design characteristics of FIR filters with linear phase – Frequency response of linear phase FIR filters - Design of FIR filters using window functions (Rectangular, Hamming, Hanning, and Blackman) - Realization structures for FIR filters.	
UNIT IV - FINITE WORD LENGTH EFFECTS	**(9)**
Fixed point and floating point number representation - ADC - quantization - truncation and rounding- quantization noise - input / output quantization - coefficient quantization error - product quantizationerror - overflow error - limit cycle oscillations due to product quantization and summation	
UNIT V - MULTIRATE SIGNAL PROCESSING	**(9)**
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor I/D – Implementation of sampling rate conversion : Polyphase filter Structures- Interchange of filters and Downsamplers /Upsamplers –Application of Multirate signal processing.	

LIST OF PROGRAMS USING MATLAB (Assignment/Online Test**):**

1. Generation of Signals Using Mat lab Function.
2. Implementation of DIT and DIF Algorithms.
3. Implementation of Linear convolution and Circular convolution.
4. Implementation of Low pass and high pass FIR filter for a given sequence.
5. Implementation of Band pass and Band stop FIR filter for a given sequence.
6. Implementation of Low pass and high pass IIR filter for a given sequence.
7. Implementation of Band pass and Band stop IIR filter for a given sequence.
8. Verification of Sampling Theorem.
9. Determination of Power Spectrum of a given signal.
10. Implementation of Decimation Process

TOTAL (L:45 P:30) : 75 PERIODS

TEXT BOOKS:

1. J.G.Proakis, D.G.Manolakis and D.Sharma, "Digital Signal Processing, Algorithms and Applications", Pearson Education, 2012.

REFERENCES:

1. S. Salivahanan, A. Vallavaraj and G.Gnanapriya, "Digital Signal Processing", Tata McGraw-Hill Company Publication Limited, 21 st Reprint 2007.
2. Oppenheim V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 2nd Edition, Prentice Hall, 2013.
3. S.K.Mitra, Digital Signal Processing, 4th Edition, TMH, 2010.
4. Lawrence R Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", PHI 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	2		2	3			2			2	1
2	3	3	2	2		2	3			3			1	2
3	3	3	3	3		3	2			2			2	2
4	3		2	2			3						1	2
5							3						2	3
CO (W.A)	3	2	2	2		2	3			2			2	2

22ECC12 – ANALOG AND DIGITAL COMMUNICATION					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : 22ECC06					
Course Objectives		**Course Outcomes**			
1.0	To provide knowledge on complete analysis of Amplitude modulation.	**1.1**	The students will be able to design parameters in various techniques of Amplitude modulation and demodulation schemes.		
2.0	To acquire knowledge about Angle modulation.	**2.1**	The students will be able to acquire the knowledge about the design techniques in Angle modulation and demodulation schemes.		
3.0	To learn the concepts of information theory and basics of error control coding.	**3.1**	The students will be able to calculate Entropy and performance of communication systems and perform error control coding.		
4.0	To analyze the performance of Baseband Transmission.	**4.1**	The students will be able to describe different methods of Pulse modulation and Baseband data transmission and reception.		
5.0	To deliberate the performance of Pass band and spread spectrum communication.	**5.1**	The students will be able to analyze the performance of various Pass band data transmission, reception techniques and spread spectrum communication.		

UNIT I - AMPLITUDE MODULATION	**(9)**
Functional block diagram of communication systems- Linear modulation schemes: Generation of AM: DSBFC using balanced modulator- Introduction to DSBSC, SSBSC and VSB Signals- Comparison of Amplitude Modulation Systems. Super heterodyne receivers- Noise in AM receivers - coherent detection, envelope detection.	
UNIT II - ANGLE MODULATION	**(9)**
Frequency modulation, Narrowband FM, Wideband FM-Generation of FM: indirect method-FM demodulation: frequency discriminator-Non linear effects in FM systems-Noise in FM receivers-capture effect-pre emphasis and de-emphasis in FM.	
UNIT III - INFORMATION THEORY AND CODING	**(9)**
Entropy and its properties-source coding theorem: Shanon-Fano coding, Discrete memory less channel-mutual information and its properties-channel coding theorem-information capacity theorem; Hamming codes- convolutional codes-Trellis diagram-Viterbi algorithm	
UNIT IV - PULSE MODULATION AND BASEBAND TRANSMISSION	**(9)**
Sampling process-PAM, PPM, PWM-Quantization process-PCM-DPCM-Delta Modulation-Adaptive delta modulation-Classification of line coding and Decoding-Matched Filter –Error rate due to noise –Inter symbol Interference-Eye patterns - Nyquist criterion for distortion less base band Binary Transmission-Correlative level coding: Duo binary with and without precoder- Modified duo binary with and without precoder.	

UNIT V - PASSBAND DATA AND SPREAD SPECTRUM MODULATION	(9)
Pass band Transmission model-Generation, detection ,signal space diagram, bit error probability and power spectra of Binary Modulation schemes (ASK,FSK,PSK), Quadrature Modulation schemes (QPSK,QAM) – Comparison of Binary and Quadrature modulation techniques. Spread Spectrum: PN sequence and its properties- Direct sequence spread spectrum-Frequency Hopping spread spectrum.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Simon Haykin, "Communications Systems", Wiley Education, 5th Edition, 2009.
2. T L Singal, "Analog & Digital Communications", Tata McGraw-Hill Education, 4th Edition, 2012

REFERENCES:

1. Taub H and Schilling D L, "Principles of Communication Systems", McGraw Hill, 4th Edition, 2017.
2. Wayne Tomasi, "Electronic Communications Systems–Fundamentals Through advanced", Pearson Education, 4th Edition, 2007.
3. Praokis J.G., "Digital Communications" 5th Edition, McGraw Hill, 2014.
4. Bernard Sklar, Pabitra Kumar Ray "Digital Communications: Fundamentals & Applications", Pearson Education, 2nd Edition, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	2							3		2	
2	3	3	2	3							2		2	
3	2	2	3	3	2								2	
4	3	2	2	2	2				2	3	2	2	3	
5	3	3	2	2	3				2	2		2	2	
CO (W.A)	2.8	2.4	2.2	2.4	2.3				2	2.5	2.3	2	2.2	

22ECP04 - ANALOG CIRCUIT DESIGN LABORATORY					
		L	T	P	C
		0	0	4	2
PRE REQUISITE : 22ECC04					
Course Objectives		**Course Outcomes**			
1.0	To make students to able to design various voltage amplifiers using Op-amp	1.1	The Students will be able to design various voltage amplifiers using Op-amp		
2.0	To make students to able construct the linear application circuits of Op-amp	2.1	The Students will be able to construct the linear application circuits of Op-amp		
3.0	To make the students able to design the Oscillator circuit using Op-amp	3.1	The Students will be able to design the Oscillator circuit using Op-amp		
4.0	To enable the students construct active filters and verify their response	4.1	The students will be able to construct active filters and verify their response		
5.0	To make the students to design and construct the application circuits of 555 timer IC	5.1	The Students will be able to design and construct the application circuits of 555 timer IC		

LIST OF EXPERIMENTS
1. Design of Inverting and Non Inverting amplifier for a specified gain using IC741.
2. Design of a Inverting and Non Inverting Summing amplifier and using IC-741.
3. Design of differentiator and integrator for a specified gain using IC741.
4. Design of a sinusoidal oscillator for specified frequency based on RC phase shift oscillators using IC-741.
5. Design of Astable Multivibrators using NE555 Timer.
6. Design of Pulse Width Modulator circuit using NE555 Timer.
6. Design of Monostable Multivibrators using NE555 Timer.
8. Design of Active LPF and HPF and plot their frequency response.
9. Study of Voltage Regulator using IC723
TOTAL (P: 60) = 60 PERIODS

Mapping of COs with POs / PSOs																
COs	**POs**												**PSOs**			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	-	-	-	-	1	-	3	2	3	1	1	2
2	3	3	2	2	-	-	-	-	1	-	3	2	3	1	1	2
3	3	2	-	2	-	-	-	-	1	-	3	2	3	1	2	3
4	3	2	-	2	-	-	-	-	1	-	3	2	3	1	2	3
5	3	2	-	2	-	-	-	-	1	-	3	2	3	1	2	3
CO (W.A)	**3**	**2.4**	**1**	**2**	**0**	**0**	**0**	**0**	**2.5**	**0**	**3**	**2**	**3**	**1**	**1.6**	**2.6**

NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabus
for
M.E. – VLSI Design [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year (2022-2023) onwards)

AUGUST 2022

INSTITUTE VISION AND MISSION	
VISION	•To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society.
MISSION	•To provide quality education to produce ethical and competent professionals with social Responsibility •To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real- world problems. •To create a learner centric environment and improve continually to meet the changing global needs.

M.E. – VLSI DESIGN	
VISION	•To foster academic excellence imparting knowledge in Electronics, Communication and allied disciplines to meet the ever growing needs of the society.
MISSION	Post graduate programme in ME VLSI Design is committed: •To impart quality education and develop an aptitude for professional career and continuous learning with ethics and social responsibility. •To provide a framework for research and innovation to meet the emerging challenges through regular interaction with industry. •To be a learner centric environment by upgrading knowledge and skills to cater the needs and challenges of the society.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	Post graduate of VLSI Design programme will be **PEO1: Core Competency:** Successful in industry by applying knowledge of VLSI Design Techniques. **PEO2: Research, Innovation and Entrepreneurship:** Able to identify, design and provide innovative solutions to solve real world social problems through research. **PEO3: Ethics, Human values and Life-long learning:** Demonstrate soft skills, professional and ethical values for a successful career through lifelong learning.
PROGRAMME SPECIFIC OUTCOMES (PSO)	At the end of this program, the students will be able to •Apply a systematic approach to solve the problems in the field of VLSI Domain. •Design an ASIC and FPGA based system using modern Electronic Design Automation tools with knowledge, techniques and skills for the benefit of industry and society.

PROGRAM OUTCOMES:

At the end of a programme the students will be

a-f	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	Research aptitude	PO1	An ability to Independently carry out research / investigation and development work to solve practical problems.
b	Technical documentation	PO2	An ability to write and present a substantial technical report/document
c	Technical competence	PO3	Able to demonstrate a degree of mastery over the areas of VLSI Systems, IC fabrication, design, testing, verification and prototype development focusing on applications.
d	Engineering Design	PO4	An ability to Identify and apply modern hardware & software tools related to create innovative products/ systems to solve real world problems in VLSI domain
e	The engineer and society	PO5	Apply technical knowledge towards the development of socially relevant products
f	Environment and sustainability	PO6	Apply appropriate managerial and technical skills in the domain of VLSI design incorporating safety and sustainability to become a successful Professional / entrepreneur through lifelong learning

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	A	B	C	D	E	F
1	3	3	3	3	3	2
2	2	3	3	2	3	3
3	3	2	1	1	2	2

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES					
	A	**B**	**C**	**D**	**E**	**F**
1	3	3	3	3	2	2
2	3	3	2	3	3	2

Contribution 1: Reasonable 2: Significant 3: Strong

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22VLA01	Graph Theory And Optimization Techniques	FC	NIL	4	3	1	0	4
2	22VLB01	Digital CMOS VLSI Design	PC	NIL	3	3	0	0	3
3	22VLB02	Semiconductor Devices and Modeling	PC	NIL	3	3	0	0	3
4	22VLA02	Digital System Design	FC	NIL	3	3	0	0	3
5	22VLB03	VLSI Signal Processing	PC	NIL	3	3	0	0	3
6	E1	Elective I	PE	Ref. PE	3	3	0	0	3
PRACTICAL									
7	22VLP01	VLSI Design Laboratory - I	PC	NIL	4	0	0	4	2
Mandatory Non Credit Courses									
8	A1	Audit Course	EEC	Ref. AC	2	2	0	0	0
				TOTAL	**25**	**20**	**1**	**4**	**21**

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22VLB04	Computer Aided Design for VLSI systems	PC	NIL	3	3	0	0	3
2	22VLB05	Analog VLSI Circuits	PC	22VLB02	3	3	0	0	3
3	22VLB06	Embedded System Design	PC	NIL	3	3	0	0	3
4	22VLB07	VLSI Testing	PC	NIL	3	3	0	0	3
5	E2	Elective II	PE / OE	Ref. PE/OE	3	3	0	0	3

6	E3	Elective III	PE	Ref. PE	3	3	0	0	3
PRACTICAL									
7	22VLP02	VLSI Design Laboratory - II	PC	22VLP01	4	0	0	4	2
8	22VLE01	Term Paper and Seminar	EEC		2	0	0	2	1
				TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	E4	Elective IV	PE	Ref. PE	3	3	0	0	3
2	E5	Elective V	PE	Ref. PE	3	3	0	0	3
3	E6	Elective VI	PE	Ref. PE	3	3	0	0	3
PRACTICAL									
4	22VLE02	Project Work (Phase- I)	EEC	NIL	12	0	0	12	6
				TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
PRACTICAL									
1	22VLE03	Project Work (Phase- II)	EEC	22VLE02	24	0	0	24	12
				TOTAL	**24**	**0**	**0**	**24**	**12**

(A) FC,PC, PE,OE, and EEC Courses

(a) Foundation Courses (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22VLA01	Graph Theory And Optimization Techniques	**FC**	NIL	4	3	1	0	4
2.	22VLA02	Digital System Design	**FC**	NIL	3	3	0	0	3

(b) Professional Core (PC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22VLB01	Digital CMOS VLSI Design	**PC**	NIL	3	3	0	0	3
2.	22VLB02	Semiconductor Devices and Modeling	**PC**	NIL	3	3	0	0	3
3.	22VLB03	VLSI Signal Processing	**PC**	NIL	3	3	0	0	3
4.	22VLB04	Computer Aided Design for VLSI systems	**PC**	NIL	3	3	0	0	3
5.	22VLB05	Analog VLSI Circuits	**PC**	22VLB02	3	3	0	0	3
6.	22VLB06	Embedded System Design	**PC**	NIL	3	3	0	0	3
7.	22VLB07	VLSI Testing	**PC**	NIL	3	3	0	0	3
8.	22VLP01	VLSI Design Laboratory - I	**PC**	NIL	4	0	0	4	2
9.	22VLP02	VLSI Design Laboratory - II	**PC**	22VLP01	4	0	0	4	2

(c)Professional Electives (PE)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22VLX01	Advanced Wireless Sensor Networks	**PE**	NIL	3	3	0	0	3
2.	22VLX02	ASIC Design	**PE**	NIL	3	3	0	0	3
3.	22VLX03	Design Of Analog Filters And Signal Conditioning Circuits	**PE**	NIL	3	3	0	0	3
4.	22VLX04	DSP with VLSI Structure	**PE**	NIL	3	3	0	0	3

5.	22VLX05	Electromagnetic Interference and Compatibility in Electronic System Design	**PE**	NIL	3	3	0	0	3
6.	22VLX06	Electronics Packaging	**PE**	NIL	3	3	0	0	3
7.	22VLX07	Genetic Algorithms for VLSI Design	**PE**	NIL	3	3	0	0	3
8.	22VLX08	Low Power VLSI Design	**PE**	22VLB01	3	3	0	0	3
9.	22VLX09	MEMS and NEMS	**PE**	NIL	3	3	0	0	3
10.	22VLX10	Nano Scale Devices	**PE**	NIL	3	3	0	0	3
11.	22VLX11	Networks On Chip	**PE**	NIL	3	3	0	0	3
12.	22VLX12	Physical Design of VLSI Circuits	**PE**	22VLB04	3	3	0	0	3
13.	22VLX13	Reconfigurable Architectures	**PE**	22VLX02	3	3	0	0	3
14.	22VLX14	RFIC Design	**PE**	NIL	3	3	0	0	3
15.	22VLX15	Power Management and Clock Distribution Circuits	**PE**	NIL	3	3	0	0	3
16.	22VLX16	System Verilog	**PE**	NIL	3	3	0	0	3
17.	22VLX17	System On Chip	**PE**	NIL	3	3	0	0	3
18.	22VLX18	VLSI for IOT Systems	**PE**	NIL	3	3	0	0	3
19.	22VLX19	Soft Computing and Optimization Techniques	**PE**	NIL	3	3	0	0	3
20.	22VLX20	Hardware and Software Co-Design for FPGA	**PE**	NIL	3	3	0	0	3
21.	22VLX21	VLSI for Wireless Communication	**PE**	NIL	3	3	0	0	3
22.	22VLX22	Signal Integrity for High Speed Design	**PE**	NIL	3	3	0	0	3
23.	22VLX23	Digital Image and Video Processing	**PE**	NIL	3	3	0	0	3

(d)Open Elective Courses (OE)									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22BAZ01	Research Methodology and IPR	**OE**	NIL	3	3	0	0	3
2.	22CPZ01	Machine Vision	**OE**	NIL	3	3	0	0	3

(e)Employability Enhancement Courses (EEC)									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	Ref. AC	Audit Course	**EEC**	NIL	2	2	0	0	0
2.	22VLE01	Term Paper and Seminar	**EEC**	NIL	2	0	0	2	1
3.	22VLE02	Project Work(Phase - I)	**EEC**	NIL	12	0	0	12	6
4.	22VLE03	Project Work (Phase - II)	**EEC**	22VLE02	24	0	0	24	12

(f) Audit Courses (AC)									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22PGA01	English for Research Paper Writing	**EEC**	NIL	2	2	0	0	0
2.	22PGA02	Disaster Management	**EEC**	NIL	2	2	0	0	0
3.	22PGA03	Constitution of India	**EEC**	NIL	2	2	0	0	0

SUMMARY						
SL. No.	SUBJECT AREA	CREDITS AS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1	FC	7	0	0	0	7
2	PC	11	14	0	0	25
3	PE	3	6	6	0	15
4	OE	0	0	3	0	3
5	EEC	0	1	6	12	19
TOTAL CREDITS		21	21	15	12	69

22VLB01 DIGITAL CMOS VLSI DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To enable the student to understand fabrication process of CMOS technology and its layout design rules.	**1.1**	The Students will be able to a Learn CMOS design rules and fabrication process.
2.0	To make students to understand the concepts of MOS transistors operations and their models	**2.1**	The Students will be able to aware about the trends in MOS transistor theory and its operation
3.0	To introduce the principles and design methodology in static and dynamic CMOS design.	**3.1**	The Students will be able to design Combinational circuits.
4.0	To introduce the principles and design methodology in sequential MOS logic circuits.	**4.1**	The Students will be able to design sequential circuits at the transistor level and compare the tradeoffs of sequencing elements including registers and latches.
5.0	To make the students to understand the concepts of arithmetic components and system level physical design	**5.1**	The Students will be examine the physical design process and analyze Adders, Multipliers and Shifters

UNIT I - FABRICATION TECHNOLOGIES	**(9)**
VLSI Manufacturing Process Steps - Crystal Growth - Wafer cleaning – Oxidation - Thermal Diffusion - Ion Implantation – Lithography –Epitaxy – Metallization -Dry and Wet etching and Packaging – P -Well process, N -Well process, twin -tub process	
UNIT II – MOS TRANSISTOR THEORY	**(9)**
NMOS and PMOS transistors, CMOS logic, MOS transistor theory –Introduction, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics, Threshold voltage-Body effect-Design equations-Second order effects. Detailed MOS gate capacitance model – Stick Diagram -and Layout Diagram and Layout Design Rules.	
UNIT III - STATIC & DYNAMIC CMOS DESIGN	**(9)**
CMOS Static & Complementary logic-CMOS Transmission Gates-Pass Transistor Circuit-Synchronous Dynamic Circuit-Dynamic CMOS Circuit Techniques-High performance CMOS Circuits.	

UNIT IV - SEQUENTIAL MOS LOGIC CIRCUITS	(9)
Static latches and registers, dynamic latches and registers, timing issues, pipelines, clocking strategies, nonbistable sequential circuits.	
UNIT V - VLSI SYSTEM COMPONENTS AND SYSTEM LEVEL PHYSICAL DESIGN	**(9)**
Arithmetic circuits–Adders, Multipliers and Shifters - Physical design –Delay modeling, cross talk, floor planning, power distribution. Clock distribution. Basics of CMOS testing.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Neil H.E. "Weste and Kamran Eshraghian, Principles of CMOS VLSI Design", Pearson Education ASIA, 3rd edition, 2007.
2. Jan M. Rabaey, AnanthaChadrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", PHI, 2nd Edition, 2016.
3. Sung-Mokang, Yusuf Leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits Analysis and Design", McGraw Hill, 4th Edition, 2016.
4. S.M.Sze, "VLSI Technology", Mc.Graw.Hill 2nd Edition. 2002.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		3	2	1		3	1
2	3	1	2	1	1		2	1
3	2	1	2	3	3	1	1	3
4	2	1	2	3	3	1	1	3
5	1	1	3	2	1	1	2	3
CO (W.A)	2	1	2	2	2	1	2	2

22VLB02 SEMICONDUCTOR DEVICES AND MODELING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Learn the basics of MOS capacitors.	**1.1**	The students will be able to know about the basics of MOSFET Operation and Modeling.
2.0	To acquire sound knowledge in MOSFET Fabrication.	**2.1**	The students will be analyze the various characteristics of Small-signal Modeling.
3.0	To understand the concept of BSIM4 MOSFET.	**3.1**	The students will be understand the Gate Dielectric Model.
4.0	To study the concept of EKV model.	**4.1**	The students will be able to know about the characteristics of Non-quasi-static Modeling.
5.0	To study the concept of Quality Assurance of MOSFET.	**5.1**	The students will be applying the Device Mismatch for Analog/RF Applications.

UNIT I - MOSFET DEVICE	**(9)**
MOS Capacitor, Interface charge, Threshold Voltage, MOS Capacitance, MOS Charge Control Model, Basic MOSFET Operation and Modeling, Advanced MOSFET Modeling.	
UNIT II -MOSFET FABRICATION AND RF MODELING	**(9)**
Typical Planar Digital CMOS Process Flow, RF CMOS Technology, Equivalent Circuit Representation of MOS Transistors, High-frequency Behavior of MOS Transistors and AC Small-signal Modeling, Model Parameter Extraction, NQS Model for RF Applications.	
UNIT III-BSIM4 MOSFET MODEL	**(9)**
Gate Dielectric Model, Enhanced Models for Effective DC and AC Channel Length and Width, Threshold Voltage Model, Channel Charge Model, Mobility Model, Source/Drain Resistance Model, I–VModel, Gate Tunneling Current Model, Substrate Current Models, RF Model.	
UNIT IV - EKV MODEL	**(9)**
Model Features, Long-channel Drain Current Model, Modeling Second-order Effects of the Drain Current, SPICE Example: The Effect of Charge-sharing, Modeling of Charge Storage Effects, Non-quasi-static Modeling, he Noise Model, Temperature Effects, Version 3.0 of the EKV Model	

UNIT V-QUALITY ASSURANCE OF MOSFET MODELS	(9)
Effects and Modeling of Process Variation and Device Mismatch, Influence of Process Variation and Device Mismatch, Modeling of Device Mismatch for Analog/RF Applications, Motivation, Benchmark Circuits, Automation of the Tests	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, "Device Modeling for Analog and RF CMOS Circuit Design", John Wiley & Sons Ltd, 2003.
2. A.B. Bhattacharyya "Compact MOSFET Models for VLSI Design", John Wiley & Sons Ltd, 2009.
3. Yuan Taur and Tak H.Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 3rd Edition 2012.
4. Behzad Razavi, "Fundamentals of Microelectronics" Wiley Student Edition, 3rd Edition,2021
5. Arora, N., "MOSFET Models for VLSI Circuit Simulation", Springer-Verlag, 1993

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	3			3	2	3	2
2	3		2	2	3		3	2
3	2	3		3	2		3	2
4	2	3	2	3			3	2
5	2	2		2		3	3	2
CO (W.A)	2.2	2.75	2	2.5	2.66	2.5	3	2

22VLA02 DIGITAL SYSTEM DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make the students able to analysis and design of Synchronous sequential machines	**1.1**	The students will be able to analysis and design of Synchronous sequential machines
2.0	To make the students able to analysis and design of hazard free Asynchronous sequential machines	**2.1**	The students will be able to analysis and design of hazard free Asynchronous sequential machines.
3.0	To make the students able to classify the faults, fault detection and diagnosing	**3.1**	The students will be able to classify the faults, fault detection and diagnosing
4.0	To make the students able to classify and describe the PLD's and FPGA's	**4.1**	The students will be able to classify and describe the PLD's and FPGA's
5.0	To make the students able to write program using Verilog code to design a digital system.	**5.1**	The students will be to write program using Verilog code to design a digital system.

UNIT I - SEQUENTIAL CIRCUIT DESIGN	**(9)**
Analysis of clocked synchronous sequential circuits and modeling-State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuits- ASM chart and System design using ASM Realization by using Multiplexer & PLA.	
UNIT II - ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN	**(9)**
Analysis of asynchronous sequential circuit – flow table reduction – races - state assignment transition table and problems in transition table - design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller	
UNIT III- FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS	**(9)**
Fault table method - path sensitization method – Boolean difference method - D algorithm - Tolerance techniques – Fault in PLA –Test generation - DFT schemes – Built in self test	

UNIT IV - SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES	(9)
Programming logic device families–Designing a synchronous sequential circuit using PLA/PAL Altera MAX 7000 –FPGA –Xilinx FPGA-Xilinx 4000.	
UNIT V- SYSTEM DESIGN USING VERILOG	**(9)**
Verilog operators – Arrays – concurrent and sequential statements –Data flow – Behavioral – structural modeling – Test bench - Using Sub circuits - Realization of combinational and sequential circuits – Registers – counters – sequential machine – serial adder – Multiplier-Divider- Introduction To System Verilog.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Stephen Brown, Zvonko Vranesic, " Fundamentals of Digital Logic with Verilog Design" , 2nd Edition Tata McGraw Hill, 2007.
2. Donald D. Givone "Digital Principles and Design" Tata McGraw Hill, 2003.
3. Floyd, Floyd Thomas L." Digital Fundamentals "Pearson Education India, 2009.
4. J. Baskar "A System Verilog Primer" Star Galaxy Publishing, India, 2018.
5. Parag K.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications, 2002.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		3	3		2	3	
2	3		3	3		2	3	
3	3		3		1	3	3	
4	3		3	2	2	3	2	3
5	3		3	3	3	3	3	3
CO (W.A)	3	0	3	2.75	2	2.6	2.8	3

22VLB03 VLSI SIGNAL PROCESSING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make students to learn and understand the various VLSI architectures for digital signal processing.	**1.1**	The students will be able to implement the various DSP design using FPGA technology.
2.0	To make the students to understand the reduction of critical path architecture design.	**2.1**	The students will be able to design arithmetic operations using critical path reduction.
3.0	To make the students to understand the reduction of critical path architecture design.	**3.1**	The students will be able to design recursive IIR filters using Algorithmic strength reduction methods.
4.0	To make the students to design various filters required for particular application.	**4.1**	The students will be able to design FIR filters using Pipelined Digital techniques.
5.0	To motivate the students to study the performance parameters, viz. area, speed and power.	**5.1**	The students will be able study the performance parameters, viz. area, speed and power through Synchronous and asynchronous pipelining.

UNIT I - INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS	**(9)**
Introduction to DSP systems – typical DSP algorithms, data flow and dependence graphs – critical path, loop bound, iteration bound, longest path matrix algorithm, pipelining and parallel processing of FIR filters, pipelining and parallel processing for low power.	
UNIT II - RETIMING, ALGORITHMIC STRENGTH REDUCTION	**(9)**
Retiming – definitions and properties, unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even, Merge-Sort architecture, parallel rank-order filters.	
UNIT III - FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS	**(9)**
Computer arithmetic techniques for low power system – reducing power consumption in combinational logic, sequential logic, memories – low power clock – advanced techniques – special techniques, adiabatic techniques – physical design, floor planning, placement and routing.	

UNIT IV - BIT-LEVEL ARITHMETIC ARCHITECTURES	(9)
Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, design of lyon‟s bit-serial multipliers using Horner‟s rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner‟s rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters	
UNIT V -NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS WAVE AND ASYNCHRONOUS PIPELINING	**(9)**
Numerical strength reduction – sub-expression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining - Bundled Data versus Dual-Rail protocol.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Yashavant Kanetkar, “Let us C”, BPB publications, New Delhi, 3rd edition, 2019.
2. PradipDey, ManasGhosh, “Fundamentals of Computing and Programming in C”, 1st edition, Oxford University Press, 2018.
3. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, 2nd edition, Tata McGraw-Hill, 2017.
4. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, 4th Reprint, 2018.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	2
2	3	2	1	2	3	-	3	2
3	-	-	1	-	-	1	3	2
4	3	3	2	2	3	2	3	2
5	3	3	-	2	3	-	3	2
CO (W.A)	3	2.5	1.33	2	3	1.5	3	2

22VLP01 VLSI DESIGN LABORATORY- I				
	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make the students to design and simulate the digital system using HDL codes	**1.1**	The Students will be able to design simulate the digital system using HDL codes
2.0	To make the students to able to analysis the SPICE modeling of Logic gates	**2.1**	The Students will be able to able to analysis the SPICE modeling of Logic gates
3.0	To make the student to able to implement the digital systems in FPGA hardware	**3.1**	The Students will be able to implement the digital systems in FPGA hardware
4.0	To make the student to able to interface the sensor with FPGA hardware	**4.1**	The Students will be able to interface the sensor with FPGA hardware
5.0	To make the student to able to interface the motors and sign boards with FPGA hardware	**5.1**	The Students will able to able to interface the motors and sign boards with FPGA hardware

List of Experiments

1. Modeling of Sequential Digital system using Verilog VHDL.
2. Modeling of Sequential Digital system using System Verilog.
3. Design and Implementation of ALU unit using FPGA.
4. Modeling of CMOS and NMOS Inverter and Logic gates using Tanner.
5. Modeling and analysis of MOS capacitor
6. Interfacing of Proximity sensor with FPGA to detect an object
7. Implementation of Stepper Motor control using FPGA.
8. Implementation of Traffic light control using FPGA.

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		3	3		2	3	
2	3		3	3		2	3	
3	3		3		1	3	3	
4	3		3	2	2	3	2	3
5	3		3	3	3	3	3	3
CO (W.A)	3		3	2.75	2	2.6	2.8	3

22VLB04 COMPUTER AIDED DESIGN FOR VLSI SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To introduce the VLSI design methodologies and design methods.	**1.1**	The Students will be able to use various VLSI design methodologies
2.0	To introduce data structures and algorithms required for VLSI design.	**2.1**	The Students will be able to understand different data structures and algorithms required for VLSI design.
3.0	To study algorithms for partitioning and placement	**3.1**	The Students will be able to develop algorithms for partitioning and placement
4.0	To study algorithms for floor planning and routing.	**4.1**	The Students will be able to develop algorithms for floor planning and routing
5.0	To study algorithms for modeling, simulation and synthesis.	**5.1**	The Students will be able to design algorithms for modeling, simulation and synthesis.

UNIT I - INTRODUCTION	**(9)**
Introduction to VLSI Design Methodologies – VLSI Design Cycle – New Trends in VLSI Design Cycle – Physical Design Cycle – New Trends in Physical Design Cycle – Design Styles – Review of VLSI Design Automation Tools.	
UNIT II -DATA STRUCTURES AND BASIC ALGORITHMS	**(9)**
Introduction to Data Structures and Algorithms – Algorithmic Graph Theory and Computational Complexity – Tractable and Intractable Problems – General Purpose Methods for Combinatorial Optimization.	
UNIT III -ALGORITHMS FOR PARTITIONING AND PLACEMENT	**(9)**
Layout Compaction – Problem Formulation – Algorithms for Constraint Graph Compaction – Partitioning – Placement – Placement Algorithms.	
UNIT IV - ALGORITHMS FOR FLOORPLANNING AND ROUTING	**(9)**
Floor planning – Problem Formulation – Floor planning Algorithms – Routing – Area Routing – Global Routing – Detailed Routing.	

UNIT V -MODELLING, SIMULATION AND SYNTHESIS	(9)
Simulation – Gate Level Modeling and Simulation – Logic Synthesis and Verification – Binary Decision Diagrams – High Level Synthesis.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", 2nd Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, Springer, 2017.
3. Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar, "Handbook of Algorithms for Physical Design Automation, CRC Press, 1st Edition.
4. N.a. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	2
2	3	2	1	2	3	-	3	2
3	-	-	1	-	-	1	3	2
4	3	3	2	2	3	2	3	2
5	3	3	-	2	3	-	3	2
CO (W.A)	3	2.5	1.33	2	3	1.5	3	2

22VLB05 ANALOG VLSI CIRCUITS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : 22VLB02 SEMICONDUCTOR DEVICES AND MODELING

Course Objectives		Course Outcomes	
1.0	To study the basis of various MOS devices modeling.	1.1	The Students can be able to design MOS single stage, multistage amplifiers.
2.0	To understand the single stage and multi stage amplifier	2.1	The Students will be able to develop design single stage and multi stage amplifier
3.0	To expose the students to acquire knowledge in design of single stage and multistage MOS amplifier	3.1	The Students will be able to analyze Stability of single stage & multistage amplifiers.
4.0	To analyze the current mirrors and reference circuits	4.1	The students will be able to analyze effect of transistor mismatch in analog design
5.0	To study about the characteristics of different design parameters in designing voltage reference and OPAMP circuits	5.1	The Students will be able to design parameters common mode and differential mode gain, frequency response of OPAMP

UNIT I - MOSFET METRICS	**(9)**
Simple long channel MOSFET theory – SPICE Models – Technology trend, Need for Analog design - Sub-micron transistor theory, Short channel effects, Narrow width effect, Drain induced barrier lowering, Sub-threshold conduction, Reliability, Small signal parameters, Unity Gain Frequency, Miller's approximation.	
UNIT II - SINGLE STAGE AND TWO STAGE AMPLIFIERS	**(9)**
Single Stage Amplifiers – Common source amplifier with resistive load, diode load, constant current load, Source degeneration Source follower, Input and output impedance, Common gate amplifier - Differential Amplifiers-differential and common mode response, Input swing, gain, diode load and constant current load-Basic Two Stage Amplifier Cut-off frequency.	
UNIT III - FREQUENCY RESPONSE OF SINGLE STAGE AND TWO STAGE AMPLIFIERS	**(9)**
Frequency Response of Single Stage Amplifiers – Noise in Single stage Amplifiers – Stability and Frequency Compensation in Single stage Amplifiers, Frequency Response of Two Stage Amplifiers – Noise in two stage Amplifiers – Stability, gain and phase margins, Frequency Compensation in two stage Amplifiers, Effect of loading in feedback networks	

UNIT IV - CURRENT MIRRORS AND REFERENCE CIRCUITS	(9)
Cascode, Negative feedback, Wilson, Regulated cascode, Bandgap voltage reference, Constant Gm biasing, supply and temperature independent reference, curvature compensation, trimming, Effect of transistor mismatch in analog design	
UNIT V - OP AMPS	**(9)**
Gilbert cell and applications, Basic two stage OPAMP, two-pole system response, common mode and differential gain, Frequency response of OPAMP, CMFB circuits, slew rate, power supply rejection ratio, random offset, systematic offset, OTA and OPAMP circuits - Low voltage OPAMP	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2000
2. Philip E.Allen, "CMOS Analog Circuit Design", Oxford University Press, 2013
3. Kenneth Martin Chan Carusone, David Johns ," Analog Integrated Circuit Design", Wiley Edition 2nd Edition, January 2013
4. Paul R.Gray, "Analysis and Design of Analog Integrated Circuits", Wiley Student edition, 5th edition, 2009.
5. R.Jacob Baker, "CMOS: Circuit Design, Layout , and Simulation", Wiley Student Edition, 2009

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	1			1	3	2
2	3	2			2		3	2
3	3		1	3		3	3	2
4		3	2	2		3	3	2
5			3	3			3	2
CO (W>A)	3	2.3	1.7	2.6	2	2.3	3	2

22VLB06 EMBEDDED SYSTEM DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the design challenges in embedded systems.	**1.1**	The student will be able to know about various design challenges in embedded system design process.
2.0	To program the Application Specific Instruction Set Processors.	**2.1**	The student will be able to understand and apply knowledge of embedded hardware development tools in system design
3.0	To understand the bus structures and protocols.	**3.1**	The student will be able to realize concepts about the networking principles and different protocols in embedded devices.
4.0	To model processes using a state – machine model.	**4.1**	The student will be able to apply state machine techniques and design process models.
5.0	To design a real time embedded system.	**5.1**	The student will be able to design suitable embedded systems for real world applications.

UNIT I - EMBEDDED SYSTEM OVERVIEW	**(9)**
Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Components, Optimizing Custom Single-Purpose Processors	
UNIT II - GENERAL AND SINGLE PURPOSE PROCESSOR	**(9)**
Basic Architecture, Pipelining, Superscalar and VLIW Architectures, Programmer's View, Development Environment, Application-Specific Instruction-Set Processors (ASIPS) Microcontrollers, Timers, Counters and Watchdog Timer, UART, LCD Controllers and Analog-to- Digital Converters, Memory Concepts	
UNIT III - BUS STRUCTURES	**(9)**
Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus - based I/O, Arbitration, Serial Protocols, I2C, CAN and USB, Parallel Protocols – PCI and ARM bus, Wireless Protocols – IRDA, Bluetooth, IEEE 802.11.	

UNIT IV - STATE MACHINE AND CONCURRENT PROCESS MODELS	(9)
Basic State Machine Model, Finite-State Machine with Data path Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, RTOS – System design using RTOS	
UNIT V - SYSTEM DESIGN	**(9)**
Burglar alarm system-Design goals -Development strategy-Software development-Relevance to more complex designs- Need for emulation -Digital echo unit-Creating echo and reverb-Design requirements-Designing the codecs - The overall system design	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & Sons, 2009.
2. Steve Heath, "Embedded System Design", Elsevier, 2nd Edition, 2004.
3. Bruce Powel Douglas, "Real Time UML, Second Edition: Developing Efficient Objects for Embedded Systems", 3rd Edition 2004, Pearson Education.
4. Daniel W.Lewis, "Fundamentals of Embedded Software where C and Assembly Meet", Pearson Education, 2004.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	3	2	1	1	3	1
2	3	1	2	1	1	1	2	1
3	2	1	2	3	3	1	1	3
4	2	1	2	3	3	1	1	3
5	1	1	3	2	1	1	2	3
CO (W.A)	2	1	2	2	2	1	2	2

22VLB07 VLSI TESTING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To introduce the VLSI testing.	**1.1**	The student will be able to know about VLSI Testing Process
2.0	To introduce logic and fault simulation and testability measures.	**2.1**	The student will be able to develop Logic Simulation and Fault Simulation.
3.0	To study the test generation for combinational and sequential circuits.	**3.1**	The student will be able to develop Test for Combinational and Sequential Circuits.
4.0	To study the design for testability.	**4.1**	The student will be able to apply the design for Testability.
5.0	To study the fault diagnosis.	**5.1**	The student will be able to Perform Fault Diagnosis.

UNIT I - INTRODUCTION TO TESTING	**(9)**
Introduction – VLSI Testing Process and Test Equipment – Challenges in VLSI Testing – Test Economics and Product Quality – Fault Modeling – Relationship Among Fault Models.	
UNIT II - LOGIC & FAULT SIMULATION & TESTABILITY MEASURES	**(9)**
Simulation for Design Verification and Test Evaluation – Modeling Circuits for Simulation – Algorithms for True Value and Fault Simulation – Scoap Controllability and Observability	
UNIT III -TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS	**(9)**
.Algorithms and Representations – Redundancy Identification – Combinational ATPG Algorithms – Sequential ATPG Algorithms – Simulation Based ATPG – Genetic Algorithm Based ATPG	
UNIT IV - DESIGN FOR TESTABILITY	**(9)**
Design for Testability Basics – Testability Analysis - Scan Cell Designs – Scan Architecture – Built in Self-Test – Random Logic BIST – DFT for Other Test Objectives.	

UNIT V -FAULT DIAGNOSIS	(9)
Introduction and Basic Definitions – Fault Models for Diagnosis – Generation of Vectors for Diagnosis – Combinational Logic Diagnosis - Scan Chain Diagnosis – Logic BIST Diagnosis.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen, "VLSI Test Principles and Architectures", Elsevier, 2017
2. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits" , Kluwer Academic Publishers, 2017.
3. Niraj K. Jha and Sandeep Gupta, "Testing of Digital Systems", Cambridge University Press, 2017.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	3	2	1	1	3	1
2	3	1	2	1	1	1	2	1
3	2	1	2	3	3	1	1	3
4	2	1	2	3	3	1	1	3
5	1	1	3	2	1	1	2	3
CO (W.A)	2	1	2	2	2	1	2	2

22VLP02 VLSI DESIGN LABORATORY- II				
	L	T	P	C
	0	0	4	2

PRE REQUISITE : 22VLP01 VLSI DESIGN LABORATORY- I

Course Objectives		Course Outcomes	
1.0	To make the student to able to interface the Relay with FPGA hardware	1.1	The Students will able to able to interface the Relay with FPGA hardware
2.0	To make the student to able to interface the LCD display with FPGA hardware	2.1	The Students will able to able to interface the LCD display with FPGA hardware
3.0	To make the student to able to interface the buzzer with FPGA hardware	3.1	The Students will be able to interface the buzzer with FPGA hardware
4.0	To make the student to able to analysis the Layout model of logic gates	4.1	The Students will be able to analysis the Layout model of logic gates
5.0	To make the student to able to analysis the Layout model of latch circuit	5.1	The Students will able to able to analysis the Layout model of latch circuit

List of Experiments

1. Implementation of the Relay control system in FPGA.
2. Implementation of the LCD display interface using FPGA.
3. Implementation of Seven segment display interface using FPGA.
4. Implementation of the Buzzer control using FPGA.
5. Implementation of the DC motor control using FPGA.
6. Layout level design of CMOS Inverter & NAND Gate using T-SPICE.
7. Layout level design of D- Latch Gate T-SPICE.

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		2	3		2	3	
2	2		3	2		2	2	
3	2		2		1	3	2	1
4	2		3	2	2	3	2	2
5	2		2	2	3	3	2	2
CO (W.A)	2	0	2	2	2	2.4	2	2

22VLE02 - PROJECT PHASE I				
	L	T	P	C
	0	0	12	6

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature, the methodology to solve the identified problem and preparing project reports and to face reviews and viva-voce examination.	1.1	At the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the phase II project work in a systematic way.

SYLLABUS:

- Student individually works on a specific topic approved by the head of the department under the guidance of a faculty member who is familiar in this area.
- The student can select any topic which is relevant to the area of VLSI Design. The topic may be executed through simulators or real time hardware.
- At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.
- The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL (P:180) : 180 PERIODS

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	3	3
CO(W.A)	3	3	3	3	3	3	3	3

22VLE03- PROJECT PHASE II				
	L	T	P	C
	0	0	24	12

PRE REQUISITE : 22VLE02

Course Objectives		Course Outcomes	
1.0	To solve the identified problem based on the formulated methodology.	1.1	On completion of the project work students will be in a position to take up any challenging practical problem in the field of Engineering design and find better solutions to it.

SYLLABUS:

- Student should continue the phase - I work on the selected topic as per the formulated methodology. At the end of the semester,
- After completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department.
- The students will be evaluated based on the report submitted and the viva -voce examination by a panel of examiners including one external examiner.

TOTAL (P:360) : 360 PERIODS

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3

22VLX01 ADVANCED WIRELESS SENSOR NETWORKS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To enable the student to understand the role of sensors and the networking of sensed data for different applications	**1.1**	The student will be able to design and implement simple wireless network concepts
2.0	To expose the students to the sensor node essentials and the architectural details, the medium access and routing issues and the energy constrained operational scenario.	**2.1**	The student will be able to analyze and implement different network architectures
3.0	To enable the student to understand the challenges in synchronization and localization of sensor nodes, topology management for effective and sustained communication, data management and security aspects	**3.1**	The student will be able to implement MAC layer and routing protocols
4.0	To design and optimize WSN architectures for various environment.	**4.1**	The student will be able to deal with timing and control issues in wireless sensor networks
5.0	To enable students to design WSN with security and low power consumption.	**5.1**	The student will be able to analyze and design secured wireless sensor networks

UNITI- OVERVIEW OF WIRELESS SENSOR NETWORKS	**(9)**
Challenges for wireless sensor networks-characteristics requirements-required mechanisms, difference between mobile ad-hoc and sensor networks, applications of sensor networks- case study, enabling technologies for wireless sensor networks.	
UNIT II- ARCHITECTURES	**(9)**
Single-node architecture - hardware components, energy consumption of sensor nodes , operating systems and execution environments, network architecture - sensor network scenarios, optimization goals and figures of merit, gateway concepts Physical layer and transceiver design considerations.	
UNIT III- MAC AND ROUTING	**(9)**
MAC protocols for wireless sensor networks IEEE 802.15.4, Zigbee, low duty cycle protocols and wakeup concepts - s-MAC , mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols- energy- efficient routing, geographic routing.	

UNIT IV- INFRASTRUCTURE ESTABLISHMENT	(9)
Topology control, clustering, time synchronization, localization and positioning, sensor tasking and control.	
UNIT V- DATA MANAGEMENT AND SECURITY	**(9)**
Data management in WSN, storage and indexing in sensor networks, query processing in sensor, data aggregation, directed diffusion, tiny aggregation, greedy aggregation, security in WSN, security protocols for sensor networks, secure charging and rewarding scheme, secure event and event boundary detection.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Erdal Çayirci , Chunming Rong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-S Technology, Protocols, and Applications", John Wiley, 2007.
4. Yingshu Li, My T. Thai,Weili Wu, "Wireless Sensor Networks and Applications", Springer, 2008.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	1				1	
2		1	2				2	1
3	3		2	1			2	
4	2			1			1	
5	1		2				2	
CO (W.A)	2.2	0.6	1.4	0.4			1.6	1

22VLX02 ASIC DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study about Logical Effort Technique for predicting Delay, Delay Minimization and FPGA Architectures.	**1.1**	The student will be able to apply Logical Effort Technique for predicting Delay, Delay Minimization and FPGA Architectures.
2.0	To familiarize the design the different types of cells.	**2.1**	The student will be able to Design Logic Cells and I/O Cells.
3.0	To learn the interconnect architecture for different types of FPGA and Programmable ASIC Design software.	**3.1**	The student will be able to analyze the various resources of recent FPGAs.
4.0	To gain knowledge about floor planning, placement and Routing algorithms for optimization of length and speed.	**4.1**	The student will be able to use algorithms for floor planning and placement of cells and to apply routing algorithms for optimization of length and speed.
5.0	To know about SoC Design and performance.	**5.1**	The student will be able to analyze SoC design and its Performance.

UNIT I - INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN	**(9)**
Types of ASICs - Design flow -CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.	
UNIT II - PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS	**(9)**
Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.	
UNIT III - PROGRAMMABLE ASIC ARCHITECTURE	**(9)**
Architecture and Configuration of ARTIX / Cyclone and KINTEX Ultra Scale / STRATIX FPGA – Micro-Blaze / NIOS Based Embedded Systems – Signal Probing Techniques.	

UNIT IV - LOGIC SYNTHESIS, PLACEMENT AND ROUTING	(9)
Logic Synthesis - Floor Planning Goals and Objectives, Measurement of Delay in Floor Planning, Floor Planning Tools, I/O and Power Planning, Clock Planning, Placement Algorithms. Routing: Global Routing, Detailed Routing, Special Routing.	
UNIT V - SYSTEM-ON-CHIP DESIGN	**(9)**
SoC Design Flow, Platform-Based and IP Based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, High Performance Filters using Delta-Sigma Modulators. Case Studies: Digital Camera, SDRAM, High Speed Data standards.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson, 2003.
2. Steve Kilts, "Advanced FPGA Design," Wiley Inter-Science.
3. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, "FPGA-based Implementation of Signal Processing Systems", Wiley, 2008.
4. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", Mc Graw Hill, 1994.
5. Douglas J. Smith, "HDL Chip Design", Madison, AL, USA: Doone Publications, 1996.
6. Jose E. France, Yannis Tsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
7. S.Pasricha and N.Dutt, "On-Chip Communication Architectures System on Chip Interconnect", Elsveir, 2008.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	2	1	-	-	-	1
2	3	-	2	1	-	-	3	2
3	3	-	2	2	1	1	1	2
4	3	-	3	2	1	1	3	2
5	3	-	3	2	1	1	3	2
CO(W.A)	3	-	2.4	1.6	1	1	2.5	1.8

22VLX03 DESIGN OF ANALOG FILTERS AND SIGNAL CONDITIONING CIRCUITS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study the basis of various CMOS circuit design.	**1.1**	The students can be able to design CMOS circuits.
2.0	To understand the concepts of various analog filter architectures.	**2.1**	The students will be able to develop analog filter architectures.
3.0	To expose the students to acquire knowledge in signal conditioning techniques.	**3.1**	The students will be able to design signal conditioning circuits.
4.0	To understand the performance of Mixed signal IC environment.	**4.1**	The students will be able to develop systems with Mixed signal IC environment.
5.0	To study about the various signal conditioning circuits.	**5.1**	The students will be able to apply the operational and design principles for active analog filter configurations

UNIT I - FILTER TOPOLOGIES	**(9)**
The Bilinear Transfer Function - Active RC Implementation, Transconductor-C Implementation, Switched Capacitor Implementation, Biquadratic Transfer Function, Active RC implementation, Switched capacitor implementation, High Q, Q peaking and instability, Transconductor-C Implementation, the Digital Biquad.	
UNIT II - INTEGRATOR REALIZATION	**(9)**
Low pass Filters, Active RC Integrators – Effect of finite Op-Amp Gain Bandwidth Product, Active RC SNR, gm-C Integrators, Discrete Time Integrators.	
UNIT III - SWITCHED CAPACITOR FILTER REALIZATION	**(9)**
Switched capacitor Technique, Biquadratic SC Filters, SC N-path filters, Finite gain and bandwidth effects, Layout consideration, Noise in SC Filters.	
UNIT IV - SIGNAL CONDITIONING TECHNIQUES	**(9)**
Interference types and reduction, Signal circuit grounding, Shield grounding, Signal conditioners for capacitive sensors, Noise and Drift in Resistors, Layout Techniques.	

UNIT V - SIGNAL CONDITIONING CIRCUITS	(9)
Isolation Amplifiers, Chopper and Low Drift Amplifiers, Electrometer and Trans -impedance Amplifiers, Charge Amplifiers, Noise in Amplifiers	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Yashavant Kanetkar, "Let us C", BPB publications, New Delhi, 3 edition, 2019.
2. PradipDey, ManasGhosh, "Fundamentals of Computing and Programming in C", 1st edition, Oxford University Press, 2018.
3. Byron S Gottfried, "Programming with C", Schaum's Outlines, 2nd edition, Tata McGraw-Hill, 2017.
4. R.G. Dromey, "How to Solve it by Computer", Pearson Education, 4th Reprint, 2018.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	2
2	3	2	1	2	3	-	3	2
3	-	-	1	-	-	1	3	2
4	3	3	2	2	3	2	3	2
5	3	3	-	2	3	-	3	2
CO (W.A)	3	2.5	1.33	2	3	1.5	3	2

22VLX04 DSP STRUCTURES FOR VLSI				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the fundamentals of DSP	**1.1**	The student will be able to acquired knowledge about fundamentals of DSP processors.
2.0	To learn various DSP structures and their implementation.	**2.1**	The student will be able to improve the overall performance of DSP system through various transformation and optimization techniques.
3.0	To know designing constraints of various filters	**3.1**	The student will be able to understand the need of different types of instructions for DSP
4.0	To design and optimize VLSI architectures for basic DSP algorithms	**4.1**	The student will be able to optimize design in terms of computation complexity and speed.
5.0	To enable students to design VLSI system with high speed and low power.	**5.1**	The student will be able to understand clock based issues and design asynchronous and wave pipelined systems

UNITI-INTRODUCTION TO DSP	**(9)**
Linear system theory- convolution- correlation - DFT- FFT- basic concepts in FIR filters and IIR filters- filter realizations. Representations of DSP algorithms- block diagram-SFG-DFG	
UNIT II- ITERATION BOUND, PIPELINING AND PARALLEL PROCESSING OF FIR FILTER	**(9)**
Data-flow graph representations- Loop bound and Iteration bound algorithms for computing iteration bound-LPM algorithm. Pipelining and parallel processing: pipelining of FIR digital filters- parallel processing, pipelining and parallel processing for low power.	
UNIT III- RETIMING, UNFOLDING AND FOLDING	**(9)**
Retiming: definitions, properties and problems- solving systems of inequalities. Properties of Unfolding, critical path, Unfolding and Retiming, applications of Unfolding, Folding transformation- register minimization techniques, register minimization in folded architecture- folding of multirate system	

UNIT IV- FAST CONVOLUTION	(9)
Cook-toom algorithm- modified cook-Toom algorithm. Design of fast convolution algorithm by inspection	
UNIT V- ARITHMETIC STRENGTH REDUCTION IN FILTERS	**(9)**
Parallel FIR filters-fast FIR algorithms-two parallel and three parallel. Parallel architectures for rank order filters -odd-even, merge-sort architecture-rank order filter architecture-parallel rank order filters-running order merge order sorter, low power rank order filter	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. K.K Parhi: "VLSI Digital Signal Processing", John-Wiley, 2nd Edition Reprint, 2008.
2. John G.Proakis, Dimitris G.Manolakis, "Digital Signal Processing", Prentice Hall of India, 1st Edition, 2009

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	1				1	2
2		1	2				2	
3	3		2	1			2	1
4	2		3	1			1	1
5	1		2				2	1
CO(W.A)	2.2	0.6	2	0.4			1.6	1

22VLX05 ELECTROMAGNETIC INTERFERENCE AND COMPATABILITY				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To gain broad conceptual understanding of the various aspects of electromagnetic (EM) Interference and compatibility.	**1.1**	The student will be able to demonstrate knowledge of the various sources of electromagnetic interference.
2.0	To develop a theoretical understanding of electromagnetic shielding effectiveness.	**2.1**	The student will be able to display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding.
3.0	To understand ways of mitigating EMI by using shielding, grounding and filtering.	**3.1**	The student will be able to explain the EMI mitigation techniques of shielding and grounding.
4.0	To understand the need for standards and to appreciate measurement methods.	**4.1**	The student will be able to explain the need for standards and EMC measurement methods.
5.0	To understand how EMI impacts wireless and broadband technologies.	**5.1**	The student will be able to discuss the impact of EMC on wireless and broadband technologies.

UNIT I - INTRODUCTION & SOURCES OF EM INTERFERENCE	**(9)**
Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures	
UNIT II - EM SHIELDING	**(9)**
Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures	
UNIT III - INTERFERENCE CONTROL TECHNIQUES	**(9)**
Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.	
UNIT IV - EMC STANDARDS, MEASUREMENTS AND TESTING	**(9)**
Need for standards - The international framework - Human exposure limits to EM fields –EMC measurement techniques - Measurement tools - Test environments. Need for standards – The international framework - Human exposure limits to EM fields –EMC measurement techniques - Measurement tools - Test environments	

UNIT V - EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES	(9)
Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Christopoulos C, "Principles and Techniques of Electromagnetic Compatibility", CRC Press, 2nd Edition, Indian Edition, 2013.
2. Clayton R.Paul," Introduction to Electromagnetic Compatibility", John Wiley Publications, 2008
3. Kodali V P, "Engineering Electromagnetic Compatibility", Wiley India, Second Edition,2010.
4. Henry W Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009.
5. Scott Bennett W, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley& Sons Inc., Wiley Inter science Series, 1997.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	3	2	2	3	2	3	3
2		2	2	3	3	2	2	2
3			2	3	2	2	3	2
4	3	3	3	3	2	3	2	2
5	2	3	2	3	3		3	3
CO(W.A)	2.6	2.75	2.2	2.8	2.6	2.25	2.6	2.4

22VLX06 ELECTRONICS PACKAGING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To study the basis of various packaging types	**1.1**	The Students can be able to develop an electronic system PCB or integrated circuit design specifications.
2.0	To understand the various semiconductor packages.	**2.1**	The Students will be able to develop Semiconductor packages.
3.0	To expose the students to acquire knowledge in CAD based design.	**3.1**	The Students will be able to select the appropriate packaging style, design procedure and solution for the same.
4.0	To understand the concept of SMD.	**4.1**	The students will be able to develop SMD based applications.
5.0	To study about the characteristics of embedded passive technology.	**5.1**	The Students will be able to apply embedded passive technology in electronic packaging.

UNIT I - OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING	**(9)**
Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.	
UNIT II - SEMICONDUCTOR PACKAGES	**(9)**
Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Electrical Design considerations in systems packaging, Resistive, Capacitive and Inductive Parasitics, Layout guidelines and the Reflection problem, Interconnection.	
UNIT III - CAD FOR PRINTED WIRING BOARDS	**(9)**
Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights, Beginning a circuit design with schematic work and component, layout, DFM check, list and design rules; Design for Reliability, Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart; Vias; PWB substrates; Surface preparation, Photo resist and application methods; UV exposure and developing; Printing technologies for PWBs, PWB etching; PWB etching; Resist stripping; Screen-printing technology, through-	

hole manufacture process steps; Panel and pattern plating methods, Solder mask for PWBs; Multilayer PWBs; Introduction to, micro vias, Micro via technology and Sequential build-up technology process flow for high-density, interconnects.	
UNIT IV - SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS	**(9)**
SMD benefits; Design issues; Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs, Solders; Wetting of solders; Flux and its properties; Defects in wave soldering, Vapour phase soldering, BGA soldering and Desoldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead free v Alloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging.	
UNIT V - EMBEDDED PASSIVES TECHNOLOGY	**(9)**
Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes, Embedded capacitors; Processes for embedding capacitors; Case study examples.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Rao R. Tummala, "Fundamentals of Microsystems Packaging", McGraw Hill, NY, 2001
2. William D. Brown, "Advanced Electronic Packaging", IEEE Press, 1999.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1	2	3	4	5	6	1	4
2	3	3	2	2	3	2	3	3
3		2	2	3	3	2	2	2
4			2	3	2	2	3	2
5	3	3	3	3	2	3	2	2
CO(W.A)	2.6	2.75	2.2	2.8	2.6	2.25	2.6	2.4

22VLX07 GENETIC ALGORITHMS FOR VLSI DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To know about analysis of Genetic algorithms and layout and test automation.	**1.1**	The students will be able to analysis and Design of Genetic algorithms and layout and test automation.
2.0	To draw a Circuit partitioning by genetic algorithms.	**2.1**	The students will be able to draw a Circuit partitioning by genetic algorithms.
3.0	To learn about different types of Standard cell placement on a network of workstations	**3.1**	The students will be able to different types of Standard cell placement on a network of workstations.
4.0	To Know about Types of genetic algorithms and parallel algorithms for ATPG	**4.1**	The students will be able to have knowledge of Types of genetic algorithms and parallel algorithms for ATPG
5.0	To have knowledge about Circuit segmentation by FPGA technology.	**5.1**	The students will be able to design Circuit segmentation through FPGA technology

UNIT I - FUNDAMENTALS OF GENETIC ALGORITHM	**(9)**
Terminologies – Simple Genetic algorithms – steady state algorithm – Genetic operators-types of GA- Genetic algorithms vs. Conventional algorithms – GA example – GA for VLSI design, layout and test automation	
UNIT II -PARTITIONING	**(9)**
Problem description – Circuit partitioning by genetic algorithms – hybrid genetic algorithms for ratio-cut partitioning.	
UNIT III-PLACEMENT AND ROUTING	**(9)**
Placement: Standard cell placement – Macro cell placement – Standard cell placement on a network of workstations Routing: Steiner problem in graph – macro cell global routing	
UNIT IV - GENETIC ALGORITHMS IN VLSI TESTING	**(9)**
Problem description – test generation frame work – test generation for test applications time reduction – deterministic/genetic test generators sequences-dynamic test sequence compaction – parallel algorithms for ATPG	

UNIT V-FPGA TECHNOLOGY MAPPING and PEAK POWER ESTIMATION	(9)
FPGA technology mapping: Circuit segmentation and FPGA mapping-circuit segmentation for Pseudo-Exhaustive testing. Peak power estimation: Problem description – application of GA – Estimation of peak single cycle and n-cycle powers-peak sustainable power estimation.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Stephen Brown, Zvonko Vranesic " Fundamentals of Digital Logic with Verilog Design" 2nd Edition Tata McGraw Hill, 2007
2. Donald D. Givone "Digital Principles and Design" Tata McGraw Hill, 2002
3. Floyd, Floyd Thomas L." Digital Fundamentals "Pearson Education India, 2005
4. Parag K.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications, 2002
5. Parag K.Lala "Digital system Design using PLD" B S Publications, 2003.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	1	1	2	3	1	1
2	2	-	-	1	1	-	2	2
3	3	1	-	3	1	2	1	3
4	2	-	1	1	1	1	1	1
5	2	2	2	2	1	2	3	2
CO (W>A)	2.4	1	0.8	1.4	1.2	1.6	1.6	1.8

22VLX08 LOW POWER VLSI DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : 22VLB01 DIGITAL CMOS VLSI DESIGN

Course Objectives		Course Outcomes	
1.0	Identify sources of power in an IC.	**1.1**	The student will be able to ability to find the power dissipation of MOS circuits.
2.0	Identify the power reduction techniques based on technology independent and technology dependent methods.	**2.1**	The student will be able to design and analyze various MOS logic circuits.
3.0	Identify suitable techniques to reduce the power dissipation.	**3.1**	The student will be able to apply low power techniques for low power dissipation.
4.0	Estimate Power dissipation of various MOS logic circuits.	**4.1**	The student will be able to able to estimate the power dissipation of ICs.
5.0	Develop algorithms for low power dissipation.	**5.1**	The student will be able to ability to develop algorithm to reduce power dissipation by software.

UNIT I - POWER DISSIPATION IN CMOS	**(9)**
Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in CMOS FET devices – Basic principle of low power design.	
UNIT II - POWER OPTIMIZATION	**(9)**
Logic level power optimization – Circuit level low power design – Gate level low power design – Architecture level low power design – VLSI subsystem design of adders, multipliers, PLL, low power design.	
UNIT III - DESIGN OF LOW POWER CMOS CIRCUITS	**(9)**
Computer arithmetic techniques for low power system – reducing power consumption in combinational logic, sequential logic, memories – low power clock – Advanced techniques – Special techniques, Adiabatic techniques.	
UNIT IV - POWER ESTIMATION	**(9)**
Power Estimation techniques, circuit level, gate level, architecture level, behavioral level, – logic power estimation – Simulation power analysis –Probabilistic power analysis.	

UNIT V - SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER	(9)
Synthesis for low power – Behavioral level transform –Algorithms for low power – software design for low power.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", Wiley, 2000.
2. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999.
3. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995.
4. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.
5. Abdelatif Belaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995.
6. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", John Wiley and sons, inc. 2001.
7. J.Rabaey, "Low Power Design Essentials (Integrated Circuits and Systems)", Springer, 2009

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	2	2	-	-	-	1
2	2	-	2	1	-	-	1	2
3	3	-	2	2	1	-	2	1
4	3	-	2	2	1	1	3	3
5	3	-	3	2	2	1	2	3
CO (W.A)	3	-	2.4	1.6	1	1	2.5	2.4

22VLX09 MEMS and NEMS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To learn about basics of MEMS and NEMS.	**1.1**	The student will be able to Interpret the fundamentals of MEMS and NEMS.
2.0	To present different ways MEMS fabrication technologies.	**2.1**	The students will be able to understand Micro system fabrication processes and Micro system packaging.
3.0	To provide idea about the design concepts of micro sensors.	**3.1**	The students will be able to deal with different types of micro sensors
4.0	To provide idea about the design concepts of micro sensors.	**4.1**	The students will be able to deal with different types of micro actuators.
5.0	It deals with the idea of nano devices.	**5.1**	The students will be familiarized with the concepts of nano devices.

UNIT I - INTRODUCTION TO MEMS AND NEMS	**(9)**
Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.	
UNIT II - MEMS FABRICATION TECHNOLOGIES	**(9)**
Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, and Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wetetching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials	
UNIT III -MICRO SENSORS	**(9)**
Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.	
UNIT IV -MICRO ACTUATORS	**(9)**
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study :RF Switch.	

UNIT V -NANO DEVICES	(9)
Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nano rods based NEMS device: Gas sensor.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Sergey Edward Lyshevski, "MEMS and NEMS Systems", Devices, and Structures",2018
2. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.
3. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.
4. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers,2001
5. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRCPress, 2002.
6. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata Mcraw Hill, 2002.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	-	3	1	-	2	2	1
2	2	-	1	2	1	-	3	2
3	3	1	-	3	1	2	2	2
4	2	-	1	2	1	1	2	1
5	-	1	2	1	1	2	2	2
CO (W.A)	2.25	1	1.75	1.8	1	1.75	2.2	1.6

22VLX11 NETWORKS ON CHIP				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Understand the concept of network - on - chip.	**1.1**	The Students will be able to Compare different architecture design.
2.0	To Learn router architecture designs.	**2.1**	The Students will be able to Implement three dimensional networks - on-chip architectures.
3.0	To study the characteristics of routing algorithms.	**3.1**	The Students will be able to implement different routing algorithms.
4.0	To Study fault tolerance network - on-chip.	**4.1**	The Students will be able to Optimize design in terms of test and fault tolerance of Noc.
5.0	To learn Three-Dimensional Networks-on-Chips.	**5.1**	The Students will be able to Optimize Chip Protocols & On-Chip Processor traffic.

UNIT I - INTRODUCTION TO NOC	**(9)**
Introduction to NoC – OSI layer rules in NoC - Interconnection Networks in Network-on-Chip Network Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support.	
UNIT II - ARCHITECTURE DESIGN	**(9)**
Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design.	
UNIT III - ROUTING ALGORITHM	**(9)**
Packet routing-Qos, congestion control and flow control – router design – network link design – Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms.	
UNIT IV - TEST AND FAULT TOLERANCE OF NOC	**(9)**
Design-Security in Networks-on-Chips-Formal Verification of Communications in Networks-on Chips-Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on-Chips.	

UNIT V - THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP	(9)
Three-Dimensional Networks-on-Chips Architectures. – A Novel Dimensionally-Decomposed Router for On-Chip Communication in 3D Architectures - Resource Allocation for QoS On-Chip Communication – Networks-on-Chip Protocols-On-Chip Processor Traffic Modeling for Networks-on-Chip.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf , "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008.
3. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-On-Chip" 2014.
4. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip Architectures" 2013.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1		2				1	
2	1		2					2
3	1		2					2
4			2		3		2	2
5	1		2		3		1	2
CO (W.A)	1		2		3		1.33	2

22VLX12 PHYSICAL DESIGN OF VLSI CIRCUITS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : 22VLB04 COMPUTER AIDED DESIGN FOR VLSI SYSTEMS

Course Objectives		Course Outcomes	
1.0	To Learn the basics of Layout Rules.	**1.1**	The student will be able to know about the basics of Layout Methodologies.
2.0	To acquire sound knowledge in Top-Down Approach.	**2.1**	The student will be able to analyze the various characteristics of FPGA.
3.0	To understand the concept of Performance Issues in Circuit Layout.	**3.1**	The student will be able to understand the various Power Minimization techniques.
4.0	To study the concept of Single-Layer Routing and Applications.	**4.1**	The students will be able to know about the characteristics of Planar Subset Problem.
5.0	To study the concept of Cell Generation and Programmable Structures.	**5.1**	The student will be able to apply the CMOS Cell Layout Generation Techniques in various applications.

UNIT I – VLSI TECHNOLOGY	**(9)**
Layout Rules and Circuit Abstraction, Cell Generation, Programmable Logic Arrays, Transistor Chaining, Weinberger Arrays and Gate Matrices, Layout Environments, Layout Methodologies, Packaging, Computational Complexity, Algorithmic Paradigms.	
UNIT II - THE TOP-DOWN APPROACH	**(9)**
Partitioning, Floor planning, Placement, Fundamentals, Maze Running, Line Searching, Steiner Trees, Global Routing, Detailed Routing, Channel Routing, Switchbox Routing, Routing in Field-Programmable Gate Arrays, Array-based FPGAs, Row-based FPGAs.	
UNIT III- PERFORMANCE ISSUES IN CIRCUIT LAYOUT	**(9)**
Delay Models, Timing-Driven Placement, Timing-Driven Routing, Delay Minimization, Clock Skew Problem, Buffered Clock Trees, Via Minimization, Power Minimization, Discussion and Other Performance Issues, ID Compaction, 2D Compaction.	
UNIT IV - SINGLE-LAYER ROUTING AND APPLICATIONS	**(9)**
Planar Subset Problem(PSP), Single-Layer Global Routing, Single-Layer Detailed Routing, Wire-Length and Bend Minimization Techniques, Length Minimization, Bend Minimization, Over-the-Cell(OTC)Routing, Physical Model of OTC Routing, Basic Steps in OTC Routing, Multichip Modules (MCMs).	

UNIT V- CELL GENERATION AND PROGRAMMABLE STRUCTURES	(9)
Programmable Logic Arrays, Transistor Chaining, Weinberger Arrays and Gate Matrix Layout, Other CMOS Cell Layout Generation Techniques, CMOS Cell Layout Styles Considering Performance Issues.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design" , Mc Graw Hill International Edition 1995
2. Preas M. Lorenzatti, "Physical Design and Automation of VLSI systems" , The Benjamin Cummins Publishers, 1998.
3. H.Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002
4. N.A Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
5. R .Drechsler, "Evolutionary Algorithms for VLSI CAD", Boston, Kluwer Academic Publishers, 2010.
6. D.Hill, D.Shugard, J.Fishburn and K.Keutzer, "Algorithms and Techniques for VLSI Layout Synthesis", Kluwer Academic Publishers, Boston, 1990.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	3			3		3	2
2	3	2			2		3	2
3	2			3			3	2
4	2	3				3	3	2
5	3	2	2				3	2
CO (W.A)_	2.4	2.5	2	3	2.5	3	3	2

22VLX13 RECONFIGURABLE ARCHITECTURES				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : 22VLX02 ASIC DESIGN

Course Objectives		Course Outcomes	
1.0	To learn about basics of reconfigurable architecture	**1.1**	The student will be able to Interpret the concept of reconfigurable systems
2.0	To present different FPGA technologies & architecture	**2.1**	The students will be able to understand programmed FPGAs
3.0	To provide idea about the routing concepts for FPGA	**3.1**	The students will be able to deal with flexibility and refutability for FPGA
4.0	To provide knowledge about different high level design style	**4.1**	The students will be able to deal with different FPGA design styles
5.0	It deals with the application development with FPGA	**5.1**	The student will be able to familiarized with the applications development with FPGA

UNIT I - INTRODUCTION TO RECONFIGURABLE ARCHITECTURES	**(9)**
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	
UNIT II - FPGA TECHNOLOGIES & ARCHITECTURE	**(9)**
Technology trends- Programming technology- SRAM programmed FPGAs, antifuse 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.	
UNIT III -ROUTING FOR FPGAS	**(9)**
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	
UNIT IV -HIGH LEVEL DESIGN	**(9)**
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.	

UNIT V -APPLICATION DEVELOPMENT WITH FPGAS	(9)
Case Studies of FPGA Applications–System on a Programmable Chip (SoPC) Designs.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Lev Kirischian, "Reconfigurable Computing Systems Engineering Virtualization of Computing Architecture" 2021
2. Christophe Bobda, "Introduction to Reconfigurable Computing –Architectures, Algorithms and Applications", Springer, 2010.
3. Clive "Max" Maxfield, "The Design Warrior"s Guide to FPGAs: Devices, Tools And Flows", Newnes, Elsevier, 2006.
4. Jorgen Staunstrup, Wayne Wlf, "Hardware/Software Co- Design: Priciples and practice", Kluwer Academic Pub, 1997.
5. Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	1
1	2	1	2	-	2	1	2	1
2	2	-	1	1	2	1	2	1
3	1		-	2	1	2	3	2
4	2	-	2	2	2	-	2	1
5	1	2	1	2	1	2	3	2
CO(W.A)	1.6	1.3	1.5	1.75	1.6	1.5	2.4	1.4

22VLX14 RFIC DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To learn the importance and issues in the design of RF.	**1.1**	The student will be able to understand the problems created in RF Design.
2.0	To design the RF filter.	**2.1**	The student will be able to know about the RF filter design.
3.0	To learn the concepts of active RF Components and its applications.	**3.1**	The student will be able to gain knowledge on active RF Components.
4.0	To know the design for RF amplifier.	**4.1**	The student will be able to design the RF amplifier circuits.
5.0	To study about the characteristics of oscillators, mixers, PLL, wireless synthesizers and detector Circuits.	**5.1**	The student will be able to learn the uses of Oscillators and Mixers in RF designs.

UNIT I – INTRODUCTION TO RF DESIGN	**(9)**
Importance of RF design- Electromagnetic spectrum, Introduction to MOSFET physics, RF behavior of passive components, chip Components and circuit board considerations, scattering parameters, smith chart and applications.	
UNIT II - RF FILTER DESIGN	**(9)**
Overview, Impedance Matching, Basic resonator and filter configuration, special filter realizations, smith chart based filter Design, coupled filter	
UNIT III - ACTIVE RF COMPONENTS AND NETWORKS	**(9)**
RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks impedance matching using discrete components, micro strip line matching networks, amplifier classes of operation and biasing networks.	
UNIT IV - RF AMPLIFIER DESIGN	**(9)**
Characteristics, amplifier power relations, stability considerations, constant gain circles, constant VSWR circles, low noise circles broadband, high power and multistage amplifier, Noises in receivers and transmitters.	

UNIT V - OSCILLATORS, MIXERS	(9)
Basic oscillator model, High Frequency oscillator configuration, basic characteristic of mixers, wireless synthesizers, phase locked loops, detector and demodulator circuits	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design -Theory and Applications", Pearson Education Asia, 1st Edition, 2001.
2. Joseph. J. Carr, "Secrets of RF Circuit Design", McGraw Hill Publishers, 3rd Edition, 2000.
3. Ulrich L. Rohde and David P. New Kirk, "RF / Microwave Circuit Design", John Wiley & Sons USA 2000.
4. Roland E. Best, "Phase - Locked Loops: Design, simulation and applications", McGraw Hill Publishers 5th Edition 2003.
5. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	3	2	2	2	2	3
2	2	1	2	3	2	1	2	2
3	2	1	2	2	2	2	3	2
4	3	1	2	2	2	1	2	2
5	2	2	2	3	2	2	3	2
CO (W.A)	2.4	1.2	2.2	2.4	2	1.6	2.4	2

22VLX16 SYSTEM VERILOG				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Apply System Verilog Concepts to Do Synthesis, Analysis and Architecture Design.	**1.1**	The student will be able to create correct, efficient, and re-usable models for digital designs using system verilog
2.0	Understanding of System Verilog and SVA for Verification and Understand The Improvements in Verification Efficiency.	**2.1**	The student will be able to use system verilog to create test benches for digital designs
3.0	Understand Advanced Verification Features, Such As The Practical Use of Classes, Randomization, Checking, and Coverage.	**3.1**	The student will be able to understand and effectively exploit new constructs in System Verilog for verification
4.0	Knowledge to Communicate The Purpose and Results of a Design Experiment in Written and Oral	**4.1**	The student will be able to understand the communication between modules
5.0	Understand The Purpose of Hardware-Software Verification	**5.1**	The student will be able to designing a complete system model using Verilog

UNIT I - VERIFICATION METHODOLOGY	**(9)**
Verification Guidelines: Introduction, Verification Process, Verification Plan, Verification Methodology Manual, Basic Test bench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Test bench Components, Layered Test bench	
UNIT II - SYSTEM VERILOG BASICS AND CONCEPTS	**(9)**
Data Types: Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Creating New Types With Type def, Creating User-Defined Structures, Enumerated Types, Constants, Strings. Procedural Statements and Routines: Procedural Statements, Tasks, Functions, and Void Functions	
UNIT III - OOPS	**(9)**
Introduction-Where to Define a Class- OOPS Terminology -Creating New Objects –Object Deallocation-Using Objects -Static Variables Vs. Global Variables -Class Routines –Defining Routines Outside of The Class - Scoping Rules -Using One Class Inside Another - Understanding Dynamic Objects -Copying Objects - Public Vs. Private -Straying Off Course - Building a Test bench	

UNIT IV - THREADS AND INTER-PROCESS COMMUNICATION AND FUNCTIONAL COVERAGE	(9)
Working With Threads, Inter-Process Communication, Events, Semaphores, Mailboxes, Building a Test bench With Threads and IPC. Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, Coverage Options, Parameterized Cover Groups, Analysing Coverage Data, Measuring Coverage Statistics	
UNIT V - COMPLETE DESIGN MODEL USING SYSTEM VERILOG- CASE STUDY	**(9)**
System Verilog ATM Example, Data Abstraction, Interface Encapsulation, Design Top Level Squat, Receivers and Transmitters, Test Bench for ATM.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Chris Spear, "System Verilog for Verification: a Guide to Learning the Test bench Language Features" , Springer 2006.
2. Janick Bergeron, Kluwer , "Writing Test benches: Functional Verification of HDL Models", 2nd Edition, Academic Publishers, 2003.
3. Stuart Sutherland, Simon David man and Peter Flake, "System Verilog for Design: a Guide to Using System Verilog for Hardware Design and Modelling", 2nd Edition, Springer
4. "Mark Glasser, Open Verification Methodology Cookbook, Springer, 2009
5. Harry D. Foster, Adam C. Krolnik, David J. Lacey, Kluwer "Assertion-Based Design, 2nd Edition, Academic Publishers, 2004.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	3	-	3	3	3	3
2	1	-	2	-	3	2	3	3
3	3	-	3	-	3	3	2	3
4	3	-	3	-	2	3	3	2
5	2	-	3	-	2	3	2	3
CO(W.A)	1.8	-	2.8	-	2.6	2.8	2.6	2.8

22VLX17 SYSTEM ON CHIP				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Learn the basics of SoC.	**1.1**	The student will be able to identify, formulate and treat complex issues in the field of system-on-chip from a holistic perspective.
2.0	To acquire sound knowledge in design methodology.	**2.1**	The student will be able to analyze the performance of SoC based design by various advanced techniques.
3.0	To understand the different types of memory design.	**3.1**	The student will be able to apply System C for system design.
4.0	To study the concept of IP based system design.	**4.1**	The students will be able to know about the characteristics of Non-quasi-static Modeling.
5.0	To study the concept of Soft Processors and Hard Processors.	**5.1**	The student will be able to apply the static timing analysis for a SoC based design.

UNIT I - SOC INTRODUCTION	**(9)**
Components of SOC- Design flow – Nature of Hardware & Software, driving factors for hardware- software co design -design space, system specification and modeling – Hardware software trade offs-Co-design approaches- Models of Computation	
UNIT II - DESIGN METHODOLOGY FOR LOGIC, MEMORY AND ANALOG CORES	**(9)**
Guidelines for design reuse - Efficiency of application specific hardware - Target architectures for HW/SW partitioning -System Integration, Embedded memories – design methodology for embedded memories – Specification of analog cores	
UNIT III - MEMORY DESIGN	**(9)**
SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies– multilevel caches – SoC memory systems – board based memory systems – simple processor / memory interaction.	

UNIT IV - IP BASED SYSTEM /DESIGN	(9)
Types of IP, IP across design hierarchy-IP life cycle- Creating and using IP-Technical concerns on IP reuse-Integration – IP evaluation on FPGA prototypes	
UNIT V - FPGA BASED EMBEDDED PROCESSOR	**(9)**
Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors and Hard Processors – Tool flow for Hardware/Software Co-design - Types of On-chip interfaces – Wishbone interface, Avalon Switch, FPGA-based Signal Interfacing and Conditioning.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf , "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008.
3. Jose L. Ayala, "Communication Architectures for Systems-on-Chip", CRC Press, 1st Edition, 2011.
4. Laung-Terng Wang, Charles E. Stroud, Nur A. Touba, "System-on-Chip Test Architectures: Nanometer Design for Testability", 1st Edition, 2010.
5. Rochit Rajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	3	3	-	3	2
2	3	2	2	2	3	-	3	1
3	-	1	2	-	1	2	2	2
4	3	3	2	2	3	2	3	2
5	3	3	-	1	2	-	3	2
CO (W.A)	3	2.5	2	2	2.75	2	2.8	1.8

22VLX18 VLSI FOR IOT SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To Learn the introduction of IoT.	**1.1**	The student will be able to infer the components of IOT and integrate it to integrated circuits to design an electronic system.
2.0	To acquire sound knowledge in Types of sensors used in IoT.	**2.1**	The student will be able to analyze the performance of SoC based design by various advanced techniques.
3.0	To understand the concept of Application Processors.	**3.1**	The student will be able to apply System C for system design
4.0	To study the concept of FPGA.	**4.1**	The students will be able to know about the characteristics of Non-quasi-static Modeling.
5.0	To study the applications of IoT.	**5.1**	The student will be able to apply the static timing analysis for a SoC based design

UNIT I – INTRODUCTION of IoT	**(9)**
Concept of connected world - Need, Legacy systems for connected world-features and limitations, Key features of IoT architecture, Merits and Demerits of IoT technology. Applications driven by IoT technology	
UNIT II - COMPONENTS OF IoT	**(9)**
Basic building blocks of an IoT system - Artificial Intelligence, Connectivity. Sensors and Computing nodes. Sensors used in IoT systems characteristics and requirements. Types of sensors properties for IoT systems – compute nodes of IoT, Connectivity technologies in IoT	
UNIT III - IC TECHNOLOGY FOR IoT	**(9)**
SoC architecture for Iot Devices - Application Processors, Microcontrollers, Smart Analog, Memory architecture for IoT - Non Volatile Memories (NVM). Embedded Non-Volatile Memories – Low Dropout Regulator, DC-to-DC Converters, Voltage References, Power Management Units (PMUS) in IC's and Systems, Role of Field Programmability in IoT systems.	
UNIT IV - ELECTRONIC SYSTEM DESIGN FOR IoT	**(9)**
Electronic System Design for IoT - Requirements, Computing blocks in IoT systems - MCU's, DSPS and FPGA, System Power Supply Design for IoT systems, Component models & System Design - System Level Integration, Operating conditions of IoT devices and impact on Electronic System Design, Hardware Security issues, EMI/EMC, SI/PI and Reliability Analysis in IOT systems.	

UNIT V - APPLICATIONS of IoT	(9)
Automated Design of Reconfigurable Micro architectures for Accelerators Under Wide-Voltage Scaling - Approximate Adder Circuits Using Clocked CMOS Adiabatic Logic (CCAL) for IoT Applications -Battery Management Technique to Reduce Standby Energy Consumption in Ultra-Low Power IoT and Sensory Applications.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Alloto. "Enabling the Internet of Things- From Integrated Circuits to Integrated Systems", Springer Publications, 1st Edition, 2017.
2. Pieter Harpe, Kofi A. A Makinwa, Andrea Baschirotto, "Hybrid ADCs, Smart Sensors for the IoT, and Sub-1V & Advanced Node Analog Circuit Design". Springer International Publishing AG, 2017.
3. Rashid Khan, Kajari Ghosh dastidar, AjithVasudevan, "Learning Iot with Particle Photon and Electron". Packt Publishing Limited (Verlag), 2016.
4. Apekmulay, "Sustaining Moore's Law : Uncertainty Leading to a Certainty of IoT Revolution", Morgan and Claypool Publishers, 2015.
5. Jim Lipman sidense Corp, "NVM Memory : A Critival Design consideration for IoT Applications"- https://www.design-reuse.com/articles/32614/nvm-memory-iot-applications.html

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	2	3	3	-	3	2
2	3	2	1	2	3	-	3	1
3	2		2		1	1	2	2
4	2	3	2	2	3	2	3	2
5	3	2	-	1	2	-	3	2
CO(W.A)	2.6	2.3	1.8	2.0	2.4	1.5	2.8	1.8

22VLX19 SOFT COMPUTING AND OPTIMIZATION TECHNIQUES				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To learn the key aspects of soft computing and Neural networks.	**1.1**	The students will be able to analysis and Design of Synchronous and Asynchronous sequential machines
2.0	To understand the features of neural network and its applications.	**2.1**	The students will be able to draw a ASM chart for digital designs
3.0	To expose the key aspects of Fuzzy Logic systems.	**3.1**	The students will be able to detect and diagnosis different faults in digital circuits
4.0	Be exposed to neuro-fuzzy hybrid systems and its applications.	**4.1**	The students will be able to Model Neuro Fuzzy system for clustering and classification.
5.0	To understand the various evolutionary optimization techniques.	**5.1**	The students will be able to use the optimization techniques to solve the real-world problems.

UNIT I - INTRODUCTIONTO SOFT COMPUTING	**(9)**
Evolution of Computing – Soft Computing Constituents – From Conventional AI to Computational Intelligence-Machine Learning Basics.	
UNIT II - NEURALNETWORKS	**(9)**
Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks–Supervised Learning Neural Networks – Reinforcement Learning –Unsupervised Learning Neural Networks – Adaptive Resonance Architectures.	
UNIT III - FUZZYLOGIC	**(9)**
Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations– Membership Functions-Fuzzy Rules and Fuzzy Reasoning– Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.	
UNIT IV - NEURO-FUZZYMODELING	**(9)**
Adaptive Neuro – Fuzzy Inference Systems – Coactive Neuro – Fuzzy Modeling –Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro – Fuzzy Control.	

UNIT V CONVENTIONAL OPTIMIZATION TECHNIQUES	(9)
Introduction to optimization techniques ¬¬– classification – Unconstrained optimization-gradient search method – Newton's Method, Marquardt Method, Constrained optimization – Interior penalty function method – external penalty function method.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Jyh-Shing RogerJang, Chuen-TsaiSun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India,2003.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009. 3. Kwang H.Lee, "First course on Fuzzy Theory and Applications", Springer–Verlag Berlin Heidelberg, 2005.
3. Georgej Klirandboyuan, "fuzzy sets and fuzzy logic – theory and applications", prentice-hall, 1995.
4. James a. freeman and David M.skapura, "Neural networks algorithms, applications, and programming techniques", pearson edn.,2003..

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	2	3	3	1	3	2
2	3	1	2	2	3	-	3	2
3	2	-	2	2	-	1	3	3
4	3	3	2	2	3	2	2	2
5	3	3	1	2	3	2	3	2
CO (W.A)	2.8	2.25	1.8	2.75	3	1.5	2.8	2.2

22VLX20 HARDWARE AND SOFTWARE CO-DESIGN FOR FPGA				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To study and compare the co-design approaches for single processor and multiprocessor architectures.	**1.1**	The student will be able to describe The Broad Range of System Architectures and Design Methodologies that currently exist and define their fundamental attributes.
2.0	To know the various techniques of Hardware and software partitioning.	**2.1**	The student will be able to discuss the Dataflow Models as a State-of-the-Art Methodology to Solve Co-Design Problems and to Optimize the balance between Software and Hardware.
3.0	To acquire the knowledge about hardware and software co-synthesis.	**3.1**	The student will be able to understand in Translating between Software and Hardware Descriptions through Co-Design Methodologies.
4.0	To study the various proto type techniques and architectures.	**4.1**	The student will be able to understand the State-of-The-Art practices in developing Co-Design Solutions to problems using modern Hardware/Software Tools for building prototypes.
5.0	To learn and implement the design specific language.	**5.1**	The student will be able to understand the Concurrent Specification from an Algorithm, Analyze its behavior and partition the Specification into Software (C Code) and Hardware (HDL) Components

UNIT I - SYSTEM SPECIFICATION AND MODELLING	**(9)**
Embedded Systems, Hardware/Software Co-Design, Co - Design for System Specification and Modeling, Co – Design for Heterogeneous Implementation - Processor Synthesis, Single – Processor Architectures with one ASIC, Single Processor Architectures with many ASICs Processor Architectures, Comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification	
UNIT II - HARDWARE/SOFTWARE PARTITIONING	**(9)**
The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph , Formulation of the HW/SW Partitioning Problem , Optimization , HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms.	
UNIT III - HARDWARE/SOFTWARE CO-SYNTHESIS	**(9)**
The Co - Synthesis Problem, State - Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis	

UNIT IV - PROTOTYPING AND EMULATION	(9)
Introduction, Prototyping and Emulation Techniques, Prototyping and Emulation Environments ,Future Developments in Emulation and Prototyping, Target Architecture Specialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems	
UNIT V - DESIGN SPECIFICATION AND VERIFICATION	**(9)**
Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System Level Specification and Design System - Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co-simulation	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.
2. Jorgen Staunstrup, Wayne Wolf ,"Hardware/Software Co-Design: Principles and Practice" , Kluwer Academic Pub, 1997.
3. Giovanni De Micheli, Rolf Ernst Morgon," Reading in Hardware/Software Co-Design" Kaufmann Publishers, 2001.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	3	-	3	3	3	3
2	1	-	2	-	3	2	3	3
3	3	-	3	-	3	3	2	3
4	3	-	3	-	2	3	3	2
5	2	-	3	-	2	3	2	3
CO (W.A)	1.8	-	2.8	-	2.6	2.8	2.6	2.8

22VLX21 VLSI FOR WIRELESS COMMUNICATION				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To make students to learn and design low noise amplifiers.	**1.1**	The student will be able to design components using low noise amplifiers.
2.0	To enable the student to understand various types of mixers.	**2.1**	The Students will be able to analyze characteristics of mixers for various operations.
3.0	To enable the student to understand the concept of PLL and Oscillators.	**3.1**	The Students will be able to design concept of PLL and various Oscillators.
4.0	To make the students to analyze data convertors and equalizers.	**4.1**	The students will be able to analyze the operation data convertors and equalizers.
5.0	To motivate the students to implement the project using VLSI architecture for Multitier Wireless System.	**5.1**	The student will be able to implement the project using VLSI architecture for Multitier Wireless System.

UNIT I - COMPONENTS AND DEVICES	**(9)**
Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers.	
UNIT II - MIXERS	**(9)**
Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer -Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer -Extrinsic Noise in Single Ended Sampling Mixer.	
UNIT III - FREQUENCY SYNTHESIZERS	**(9)**
Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).	

UNIT IV - UB SYSTEMS	(9)
Data converters in communications, adaptive Filters, equalizers and transceivers.	
UNIT V - IMPLEMENTATIONS	**(9)**
VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
2. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
3. homas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits", Cambridge University Press, 2003.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design -Circuits and Systems", Kluwer Academic Publishers, 2000.
5. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.
6. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2			1	1	2
2				2		2	2	
3				2			2	2
4			2	2			1	1
5	1			2	1		2	3
CO (W.A)	1		2	2	1	1.5	1.6	2

22VLX22 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To know about analysis and Design of Transmission line and propagation of signal and design of PCB layer.	**1.1**	The students will be able to analysis of Transmission line and Design of PCB layer.
2.0	To learn about Multi-conductor transmission and cross-talk lines.	**2.1**	The students will be able to conduct and detect the Multi-conductor transmission and cross-talk lines.
3.0	To learn about different Non-ideal signal return paths and Transmission line losses models.	**3.1**	The students will be able to detect Non-ideal signal return paths and diagnosis different faults in Transmission line losses models.
4.0	To Know about Types of Power Considerations and transmission systems design.	**4.1**	The students will be able to have knowledge of Power Considerations and transmission systems design.
5.0	To have knowledge about clock distribution and clock oscillators.	**5.1**	The students will be able to design the clock distribution through clock oscillators.

UNIT I - SIGNAL PROPAGATION ON TRANSMISSION LINES	**(9)**
Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance, wave propagation, reflection, and bounce diagrams Reactive terminations – L, C, static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stack ups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for micro strip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion	
UNIT II -MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK	**(9)**
Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and micro strip) Differential signaling, termination, balanced circuits, S-parameters, Lossy and Lossless models	
UNIT III-NON-IDEAL EFFECTS	**(9)**
Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, tanδ, routing parasitic, Common-mode current, differential-mode current, Connectors	

UNIT IV - POWER CONSIDERATIONS AND SYSTEM DESIGN	(9)
SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis	
UNIT V-CLOCK DISTRIBUTION AND CLOCK OSCILLATORS	**(9)**
Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, cancelling parasitic capacitance, Clock jitter	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR, 2003 .
2. Eric Bogatin , Signal Integrity – Simplified , Prentice Hall PTR, 2003.
3. H. W. Johnson and M. Graham, "High-Speed Digital Design: A Handbook of Black Magic", Prentice Hall, 1993.
4. S. Hall, G. Hall, and J. McCall, "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", Wiley-Inter science, 2000

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	2	-	2	3	3	2	1
2	2	1	1	1	2	1	3	2
3	3	2	2	1	1	1	-	2
4	1	-	1	2	2	-	2	3
5	3	1	3	3	1	1	1	1
CO (W.A)	2.2	1.2	1.4	1.8	1.8	1.4	1.6	1.8

22VLX23 DIGITAL IMAGE AND VIDEO PROCESSING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To know about digital image fundamentals, image enhancements and filtering	**1.1**	The students will be able to understand basic of digital image fundamentals, image enhancements and filtering
2.0	To know about color image processing and segmentation	**2.1**	The students will be able to know about colour image processing and segmentation
3.0	To learn about wavelets and multi-resolution image processing	**3.1**	The students will be to able learn about wavelets and multi-resolution image processing
4.0	To do and know image compression techniques for different images	**4.1**	The students will be able do and know image compression techniques for different images
5.0	To have knowledge about video coding segmentation	**5.1**	The student will be able to acquire knowledge about video coding segmentation

UNIT I - DIGITAL IMAGE FUNDAMENTALS	**(9)**
Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel domain sharpening filters, frequency domain filters	
UNIT II - COLOUR IMAGE PROCESSING AND SEGMENTATION	**(9)**
Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Detection of discontinuities, edge linking and boundary detection, thresholding: global and adaptive, region-based segmentation.	
UNIT III - WAVELETS AND MULTI-RESOLUTION IMAGE PROCESSING	**(9)**
Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.	
UNIT IV - IMAGE COMPRESSION	**(9)**
Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.	

UNIT V - VIDEO CODING SEGMENTATION	(9)
Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X. Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.	
TOTAL (L:45) :45 PERIODS	

REFERENCES:

1. M. Tekalp ,"Digital video Processing", Prentice Hall International.
2. Gonzaleze and Woods ,"Digital Image Processing ", 3rd edition , Pearson
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	2	-	1	1	1	2	-
2	2	2	1	1	1	1	-	3
3	2	2	-	1	-	1	-	3
4	2	2	1	-	-	2	1	2
5	2	2	-	-	-	2	1	2
CO (W.A)	2	2	0.4	0.6	0.2	1.4	0.8	2