GOVERNMENT COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University)

BARGUR-635104

Curriculum and Syllabus
For

ELECTRONICS AND COMMUNICATION ENGINEERING
(Full Time)

I TO VIII SEMESTERS

2020

Regulation
AY 2020-2021 onwards

OFFICE OF CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF ENGINEERING

BARGUR – 635 104

Website: www.gcebargur.ac.in

PROGRAMME SPECIFIC OUTCOMES	
1.	Graduates will be able to understand and apply the concepts of Electronics and Communication Engineering in the field of Communication, Microelectronics, Signal processing, Networking, Embedded and VLSI Systems.
2.	Graduates will be able to design and utilize advanced Hardware and Software tools to analyse and implement subsystems for real time applications.
3.	Graduates will be able to apply domain knowledge to enhance research in the field of Communication Engineering, Embedded Systems and VLSI Systems.
PROGRAM EDUCATIONAL OBJECTIVES	
1.	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3.	**Design/Development of solutions:** Design solution for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the culture, societal and environmental considerations.
4.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretations of data, and synthesis of the information to provide valid conclusions.
5.	**Modern tool usage:** Create, Select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	**The engineer and society:** Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	**Environmental and sustainability:** Understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	**Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings
10.	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management and finance principles and apply these to one's own work, as a member and leader in a team, to manage projects and multidisciplinary environments.
12.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ELECTRONICS AND COMMUNICATION ENGINEERING (UG)

CURRICULUM DESIGN

CREDIT SUMMARY

SL. NO	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS ACTUAL	CREDITS AICTE	% OF CREDITS	TOTAL NO. OF COURSES
		I	II	III	IV	V	VI	VII	VIII				
1.	**HSM**	3				3		3		9	12	5.61	4
2.	**BS**	11.5	8.5	4	4					28	25	17.45	9
3.	**ES**	6	4.5	8.5		3				22	24	13.71	9
4.	**PC**		4	10	18	11	11	7		61	48	38.63	27
5.	**PE**					3	6	3	6	18	18	11.25	6
6.	**OE**						3	6	3	12	18	7.48	4
7.	**ECP**					1.5		3	6	10.5	15	6.54	3
8.	**MC**	0	0	0						0			3
9.	**TOTAL**	**20.5**	**17**	**22.5**	**22**	**21.5**	**20**	**22**	**15**	**160.5**	**160**	**100**	**64**

GOVERNMENT COLLEGE OF ENGINEERING
BARGUR

CBCS– 2020 REGULATIONS

Curriculum for Full Time – B.E (ECE)

From the Academic Year 2020-2021 onwards

INDUCTION PROGRAM (Mandatory)

Induction program	3 Week Program
To be offered at the start of the first semester	• Creative arts • Universal Human Values • Literary Activities • Yoga/Physical Activities • Proficiency Modules • Lectures by Eminent People • Familiarization to Department/Branch & Innovations

SEMESTER - I

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ZBS101	Engineering Mathematics - I	BSC	4	3	1	0	4
2.	20ZBS102	Engineering Physics	BSC	3	3	0	0	3
3.	20ZES103	Engineering Graphics	ESC	5	1	0	4	3
4.	20ZHS104	Technical English	HSMC	2	2	0	0	2
5.	20ZBS105	Engineering Chemistry	BSC	3	3	0	0	3
PRACTICAL								
6.	20ZBS108	Chemistry Laboratory	BSC	3	0	0	3	1.5
7.	20ZHS109	Communication English Laboratory	HSMC	2	0	0	2	1
8.	20LES110	Workshop Practices	ESC	5	1	0	4	3
		TOTAL		**27**	**13**	**1**	**13**	**20.5**

SEMESTER - II

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ZBS201	Engineering Mathematics - II	BSC	4	3	1	0	4
2.	20ZBS202	Physics of Semiconductor Devices	BSC	3	3	0	0	3
3.	20ZES203	Programming in C	ESC	3	3	0	0	3
4.	20LPC204	Circuit Theory	PCC	3	3	0	0	3
5.	20ZMC205	Constitution of India	MC	1	1	0	0	0
PRACTICAL								
6.	20ZBS208	Physics Laboratory	BSC	3	0	0	3	1.5
7.	20ZES209	Programming in C Laboratory	ESC	3	0	0	3	1.5
8.	20LPC210	Circuits and Devices Laboratory	PCC	2	0	0	2	1
			TOTAL	**22**	**13**	**1**	**8**	**17**

SEMESTER - III

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ZBS301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2.	20LPC302	Electronic Circuits - I	PCC	3	3	0	0	3
3.	20LPC303	Electromagnetic Fields	PCC	3	3	0	0	3
4.	20LPC304	Signals and Systems	PCC	3	3	0	0	3
5.	20LES305	Data Structures and Object-Oriented Programming Language	ESC	3	3	0	0	3
6.	20ZMC306	Environmental Science and Engineering	MC	1	1	0	0	0
7.	20LES307	Basic Electrical and Instrumentation Engineering	ESC	3	3	0	0	3
PRACTICAL								
8.	20LES308	Data Structures and Object Oriented Programming Language Laboratory	ESC	3	0	0	3	1.5
9.	20LPC309	Electronic Circuits - I Laboratory	PCC	2	0	0	2	1
10.	20LES310	Electrical Engineering Laboratory	ESC	2	0	0	2	1
			TOTAL	**27**	**19**	**1**	**7**	**22.5**

SEMESTER– IV

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ZBS401	Probability and Random Processes	BSC	4	3	1	0	4
2.	20LPC402	Electronic Circuits - II	PCC	3	3	0	0	3
3.	20LPC403	Digital Signal Processing	PCC	3	3	0	0	3
4.	20LPC404	Transmission Lines and Waveguides	PCC	3	3	0	0	3
5.	20LPC405	Analog Communication	PCC	3	3	0	0	3
6.	20LPC406	Digital Electronics	PCC	3	3	0	0	3
PRACTICAL								
7.	20LPC408	Electronic Circuits - II Laboratory	PCC	2	0	0	2	1
8.	20LPC409	Digital Electronics Laboratory	PCC	2	0	0	2	1
9.	20LPC410	Digital Signal Processing Laboratory	PCC	2	0	0	2	1
			TOTAL	**25**	**18**	**1**	**6**	**22**

SEMESTER– V

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20LES501	Basic Control System Engineering	ESC	3	3	0	0	3
2.	20LPC502	Digital Communication	PCC	3	3	0	0	3
3.	20LPC503	Antenna and Wave Propagation	PCC	3	3	0	0	3
4.	20LHS504	Management Theory and Practice	HSMC	3	3	0	0	3
5.	20ZPC505	Microprocessor and Microcontroller	PCC	3	3	0	0	3
6.		Professional Elective I	PEC	3	3	0	0	3
PRACTICAL								
7.	20LPC508	Analog Communication Laboratory	PCC	2	0	0	2	1
8.	20ZPC509	Microprocessor and Microcontroller Laboratory	PCC	2	0	0	2	1
9.	20LPR510	Project - I	PROJ	3	0	0	3	1.5
			TOTAL	**25**	**18**	**0**	**7**	**21.5**

SEMESTER– VI

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20LPC601	VLSI Design	PCC	3	3	0	0	3
2.	20LPC602	RF and Microwave Systems	PCC	3	3	0	0	3
3.	20LPC603	Communication Networks	PCC	3	3	0	0	3
4.		Professional Elective - II	PEC	3	3	0	0	3
5.		Professional Elective - III	PEC	3	3	0	0	3
6.		Open Elective - I	OEC	3	3	0	0	3
PRACTICAL								
7.	20LPC608	VLSI Laboratory	PCC	2	0	0	2	1
8.	20LPC609	Digital Communication and Networks Laboratory	PCC	2	0	0	2	1
			TOTAL	**22**	**18**	**0**	**4**	**20**

SEMESTER– VII

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20ZHS701	Professional Ethics	HSMC	3	3	0	0	3
2.	20LPC702	Fiber Optic Communication	PCC	3	3	0	0	3
3.	20LPC703	Wireless Communication	PCC	3	3	0	0	3
4.		Professional Elective - IV	PEC	3	3	0	0	3
5.		Open Elective - II	OEC	3	3	0	0	3
6.		Open Elective - III	OEC	3	3	0	0	3
PRACTICAL								
7.	20LPC708	Microwave and Optical Laboratory	PCC	2	0	0	2	1
8.	20LPR709	Project - II	PROJ	6	0	0	6	3
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER– VIII

SL. No.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective - V	PEC	3	3	0	0	3
2.		Professional Elective - VI	PEC	3	3	0	0	3
3.		Open Elective - IV	OEC	3	3	0	0	3
PRACTICAL								
4.	20LPR808	Project - III	PROJ	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

TOTAL NUMBER OF CREDITS: 160.5

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20LPE001	Wireless Networks	PEC	3	3	0	0	3
2.	20LPE002	Ad-hoc Networks	PEC	3	3	0	0	3
3.	20LPE003	Network Security	PEC	3	3	0	0	3
4.	20LPE004	Internet of Things	PEC	3	2	1	0	3
5.	20LPE005	Statistical Theory of Communication	PEC	3	2	1	0	3
6.	20LPE006	Spread Spectrum Techniques	PEC	3	3	0	0	3
7.	20LPE007	Communication Electronic Circuits	PEC	3	3	0	0	3
8.	20LPE008	Telecommunication Switching Networks	PEC	3	3	0	0	3
9.	20LPE009	Software Defined Radio	PEC	3	3	0	0	3
10.	20LPE010	Automotive Electronic Systems	PEC	3	3	0	0	3
11.	20LPE011	Advanced Display Devices	PEC	3	3	0	0	3
12.	20LPE012	Digital Speech Processing	PEC	3	2	1	0	3
13.	20LPE013	Advanced Digital Signal Processing	PEC	3	2	1	0	3
14.	20LPE014	DSP Architectures and Programming	PEC	3	3	0	0	3
15.	20LPE015	Digital Image Processing	PEC	3	3	0	0	3
16.	20LPE016	MEMS	PEC	3	3	0	0	3
17.	20LPE017	Nanoelectronics	PEC	3	3	0	0	3
18.	20LPE018	Optoelectronics	PEC	3	3	0	0	3
19.	20LPE019	Radar Systems	PEC	3	3	0	0	3
20.	20LPE020	Smart Antennas	PEC	3	3	0	0	3
21.	20LPE021	Wavelet Transform and Applications	PEC	3	3	0	0	3
22.	20LPE022	VLSI Testing	PEC	3	3	0	0	3
23.	20LPE023	ARM System Design	PEC	3	3	0	0	3
24.	20LPE024	Analog Integrated Circuits Design	PEC	3	3	0	0	3
25.	20LPE025	Microwave Integrated Circuits	PEC	3	3	0	0	3

LIST OF OPEN ELECTIVES

(OFFERED TO OTHER DEPARTMENT STUDENTS)

S.NO	COURSE CODE	COURSE TITLE	CAT	L	T	P	C
1.	20LOE001	Real Time Systems	OEC	3	0	0	3
2.	20LOE002	Wireless Sensor Networks	OEC	3	0	0	3
3.	20LOE003	Industrial Automation and Robotics	OEC	3	0	0	3
4.	20LOE004	Principles of VLSI Design	OEC	3	0	0	3
5.	20LOE005	Applied Electronics	OEC	3	0	0	3
6.	20LOE006	Fundamentals of Wireless Networks	OEC	3	0	0	3
7.	20LOE007	Fundamentals of IoT	OEC	3	0	0	3
8.	20LOE008	Soft Computing	OEC	3	0	0	3

VALUE ADDED COURSES

Students can undergo "Internship" in Government/Government recognized industries/organizations for a period of four to six weeks. This will be indicated in the grade sheet as "Value Added Courses".

LIST OF MANDATORY COURSES

SL.No.	COURSE CODE	COURSE TITLE
1.		Induction Program
2.	20ZMC205	Constitution of India
3.	20ZMC306	Environmental Sciences and Engineering

LIST OF BASIC SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CAT	L	T	P	C
1.	20ZBS101	Engineering Mathematics I	BSC	3	1	0	4
2.	20ZBS102	Engineering Physics	BSC	3	0	0	3
3.	20ZBS103	Engineering Chemistry	BSC	3	0	0	3
4.	20ZBS108	Chemistry Laboratory	BSC	0	0	3	1.5
5.	20ZBS201	Engineering Mathematics II	BSC	3	1	0	4
6.	20ZBS202	Physics of Semiconductor Devices	BSC	3	0	0	3
7.	20ZBS209	Physics Laboratory	BSC	0	0	3	1.5
8.	20ZBS301	Transforms and Partial Differential Equations	BSC	3	1	0	4
9.	20ZBS401	Probability and Random Processes	BSC	3	1	0	4

LIST OF HUMANITIES AND MANAGEMENT SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CAT	L	T	P	C
1.	20ZHS104	Technical English	HSMC	2	0	0	2
2.	20ZHS109	Communication English Laboratory	HSMC	0	0	2	1
3.	20LHS502	Management Theory and Practice	HSMC	3	0	0	3
4.	20ZHS701	Professional Ethics	HSMC	3	0	0	3

LIST OF ENGINEERING SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CAT	L	T	P	C
1.	20ZES105	Engineering Graphics	ESC	1	0	4	3
2.	20ZES110	Workshop Practices	ESC	1	0	4	3
3.	20ZES203	Programming in C	ESC	3	0	0	3
4.	20ZES208	Programming in C Laboratory	ESC	0	0	3	1.5
5.	20LES305	Data Structures and Object-Oriented Programming Language	ESC	3	0	0	3
6.	20LES307	Basic Electrical and Instrumentation Engineering	ESC	3	0	0	3
7.	20LES308	Data Structures and Object Oriented Programming Language Laboratory	ESC	0	0	3	1.5
8.	20LES310	Electrical Engineering Laboratory	ESC	0	0	2	1
9.	20LES501	Basic Control System Engineering	ESC	3	0	0	3

LIST OF PROFESSIONAL CORE COURSES

S.NO	COURSE CODE	COURSE TITLE	CAT	L	T	P	C
1.	20LPC204	Circuit Theory	PCC	3	0	0	3
2.	20LPC210	Circuits and Devices Laboratory	PCC	0	0	2	1
3.	20LPC302	Electronic Circuits – I	PCC	3	0	0	3
4.	20LPC303	Electromagnetic Fields	PCC	3	0	0	3
5.	20LPC304	Signals and Systems	PCC	3	0	0	3
6.	20LPC309	Electronic Circuits - I Laboratory	PCC	0	0	2	1
7.	20LPC402	Electronic Circuits – II	PCC	3	0	0	3
8.	20LPC403	Digital Signal Processing	PCC	3	0	0	3
9.	20LPC404	Transmission Lines and Waveguides	PCC	3	0	0	3
10.	20LPC405	Analog Communication	PCC	3	0	0	3
11.	20LPC406	Digital Electronics	PCC	3	0	0	3
12.	20LPC408	Electronic Circuits - II Laboratory	PCC	0	0	2	1
13.	20LPC409	Digital Electronics Laboratory	PCC	0	0	2	1
14.	20LPC410	Digital Signal Processing Laboratory	PCC	3	0	0	3
15.	20LPC503	Digital Communication	PCC	3	0	0	3
16.	20LPC504	Antenna and Wave Propagation	PCC	3	0	0	3
17.	20LPC505	Microprocessors and Microcontrollers	PCC	3	0	0	3
18.	20LPC508	Analog Communication Laboratory	PCC	0	0	2	1
19.	20LPC509	Microprocessor and Microcontroller Laboratory	PCC	0	0	2	1
20.	20LPC601	VLSI Design	PCC	3	0	0	3
21.	20LPC602	RF and Microwave system	PCC	3	0	0	3

22.	20LPC603	Communication Networks	PCC	3	0	0	3
23.	20LPC608	VLSI Laboratory	PCC	0	0	2	1
24.	20LPC609	Digital Communication and Networks Laboratory	PCC	0	0	2	1
25.	20LPC702	Fiber Optic Communication	PCC	3	0	0	3
26.	20LPC703	Wireless Communication	PCC	3	0	0	3
27.	20LPC708	Microwave and Optical Laboratory	PCC	0	0	2	1

EVALUATIONS :: 2020 REGULATIONS

Each course shall be evaluated for a maximum of 100 marks as shown below:

Sl. No	Category of course	Continuous Assessment	End-Semester Examinations
1.	Theory Courses	50 Marks	50 Marks
2.	Laboratory Courses	50 Marks	50 Marks
3.	Project Work	50 Marks	50 Marks
4.	All other EEC Courses (non theory)	100 Marks	-

Continuous Assessment Mark the following guidelines are to be followed.

Sl.No.	Category Details	CA Marks	Weightage
1.	Test (3 Nos.) {each test is to be conducted for 50 Marks}	30 Marks	60%
2.	Assignment (3 Nos.)	20 Marks	40%
	TOTAL	50 Marks	100%

Marks for Project Work and the Viva-Voce Examination will be distributed as indicated below.

Continuous Assessment 50 Marks				End Semester Examination 50 Marks		
Review I (25 Marks)		Review II (25 Marks)		Report Evaluation (20 Marks)	Viva-Voce (30 Marks)	
Review Committee (Excluding Guide)	Guide	Review Committee (Excluding Guide)	Guide	External Examiner	External Examiner	Internal Examiner **
15	10	15	10	20	15	15

**Guide will be the internal

A student has to **secure minimum of 75% attendance** for appearing end semester examination. If a student secures **65% to 75% attendance** in the Current Semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International Level Sports events with prior permission from the Head of the Department concerned, the student shall apply for **condonation**. Condonation can be allowed only two semesters (i.e **only two condonations**) during the entire course of study.

Students who secure **less than 65% attendance** will **not be permitted to write the End-Semester Examination.**

SPECIAL NOTE: All the students should undergo Internship (4 to 6 weeks duration) asa value added course. This will be indicated in the Grade Sheet under the head, "**Value Added Courses**.

FIRST SEMESTER

20ZBS101	ENGINEERING MATHEMATICS- I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- matrix algebra and techniques and using them in engineering applications
- the concept of infinite series and their convergence so that they will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modelling.
- differential and integral calculus and their applications in various engineering applications

UNIT I	MATRICES	9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II	SEQUENCES AND SERIES	9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III	APPLICATIONS OF DIFFERENTIAL CALCULUS	9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV	FUNCTIONS OF SEVERAL VARIABLES	9+3

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

UNIT V	MULTIPLE INTEGRALS	9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

	TOTAL : 60 PERIODS

COURSE OUTCOMES	
1.	solve problems on matrices and to apply concepts of matrix theory whenever applicable in the field of engineering
2.	solve problems using convergence tests on sequences and series and to apply them in engineering field appropriately
3.	solve problems on differential and integral calculus and will be exposed to their applications in engineering
TEXT BOOKS:	
1.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.
REFERENCES:	
1.	*Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Ltd., 2011.*
2.	*Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.*
3.	*Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.*
4.	*Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.*
5.	*Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume II, Second Edition, PEARSON Publishing, 2011.*

20ZBS102	ENGINEERING PHYSICS	L	T	P	C
	(Common to MECH, EEE, ECE & CSE)	3	0	0	3

OBJECTIVES:

- To develop knowledge on properties of solids
- To understand the properties of conducting and semiconducting materials
- To become proficient in magnetic and dielectric materials
- To apply principles of quantum physics in the engineering field
- To know about the fundamentals of LASER and fibre optics and its applications

UNIT I	PROPERTIES OF MATTER	9

Elasticity – Hooke's law – Stress – Types of Stresses – Strain- Types of Strain -Young's Modulus – Rigidity Modulus – Bulk Modulus –Poisson's ratio – Relationship between three elastic constants and Poisson's ratio– Torsional Pendulum – Factors affecting elasticity of materials - Bending moment of a Beam – Depression of cantilever (Theory and Experiment) – Determination of Young's modulus – Uniform and non-uniform bending (Theory and Experiment).

UNIT II	THERMAL PHYSICS	9

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conductions in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation.

UNIT III	QUANTUM PHYSICS	9

Blackbody radiation – Wien's displacement law – Rayleigh-Jean's law - Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh-Jean's law – Matter waves – De-Broglie's Hypothesis – Properties of matter waves - Wave-particle duality – Wavefunction and its physical Significance – Schrodinger wave equation – Time-dependent and time-independent – Application of Schrodinger wave equation: Particle in a 1 D box.

UNIT IV	LASERS	9

LASER – Interaction of light radiation with materials – Einstein's A and B coefficient derivation – Concept of LASER – Population inversion – Pumping action – Methods for pumping action – Characteristics of LASER – Principle, construction and working of Nd-YAG – Industrial and medical applications of lasers.

UNIT V	FIBRE OPTICS	9

Structure of Optical Fibre – Guiding mechanism – Total internal reflection – Critical Angle – Conditions for total internal reflection – Principle and Propagation of light in Optical Fibres –

Numerical aperture and acceptance angle – Types of optical fibres (Material, refractive index and mode) – their characteristics and applications.	
TOTAL:45 PERIODS	
OUTCOMES:	
•	To learn about three types of elastic moduli and able to calculate them for different materials
•	To apply concepts of thermal properties of materials and their applications in expansion joints and heat exchangers
•	To understand the quantum nature of materials and apply fundamental principles of quantum physics to the engineering field.
•	To understand the working principles of lasers and their types
•	To know about fibre optics and mechanism of propagation of light through them.
TEXTBOOKS:	
1.	D.K. Bhattacharya & T. Poonam. "Engineering Physics". Oxford University Press, 2015.
2.	R.K. Gaur & S.L. Gupta. "Engineering physics". Dhanpat Rai Publishers, 2012.
3.	A.Marikani, "Engineering Physics", PHI Learning Pvt., India 2009
4.	B.K. Pandey & S. Chaturvedi. "Engineering Physics". Cengage Learning India, 2012.
REFERENCES:	
1.	*D. Haliday, R. Resnick and J. Walker. "Principles of Physics". Wiley, 2015*
2.	*M. N. Avadhanulu and P. G. Kshirsagar, "A textbook of engineering physics", S. Chand and Company Ltd, New Delhi, 2005.*
3.	*K. Rajagopal, "Engineering Physics", PHI, New Delhi, 2011.*
4.	*R.A. Serway & J.W. Jewett. "Physics for Scientist and Engineers". Cengage Learning, 2010.*
5.	*M. Arumugam, "Engineering physics", Anuradha publishers*

20ZBS105	ENGINEERING CHEMISTRY	L	T	P	C
	(Common to ECE and CSE)	3	0	0	3

OBJECTIVES:

•	To make students conversant with water parameters, boilers, need for water treatment and its merits and demerits.
•	Students ought to be aware of fundamental principles behind different electrochemical reactions, corrosion of materials and methods to prevent corrosion.
•	To learn the chemistry behind polymers, synthesis, merits, demerits and its applications in various field.
•	To acquire basic knowledge in renewable, non renewable and alternate energy resources and the chemical reactions involved in cell, batteries and its applications.
•	To learn the working principle of various spectroscopy and its applications. To acquire basic knowledge in Nano materials, synthesis, properties and uses.

UNIT I WATER TECHNOLOGY 9

Characteristics – alkalinity and its significance – hardness (problems) - types and estimation by EDTA method – specifications of drinking water (BIS and WHO standards) – potable water treatment – boiler feed water - requirements – disadvantages of using hard water in boilers (Scales & Sludge, Boiler corrosion, Priming & Foaming, Caustic embrittlement) – water treatment – Internal treatment – external treatment – zeolite method - Demineralization process – desalination – reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry: Electrochemical cells – reversible and irreversible cells – EMF – measurement of EMF – single electrode potential – Nernst equation (Problems) – reference electrode – standard hydrogen electrode and calomel electrode – ion selective electrode – glass electrode and measurement of pH – electrochemical series and its applications.

Corrosion: Corrosion – Pilling Bedworth rule - dry corrosion and its mechanism - electrochemical corrosion and its mechanism – types (galvanic, pitting, differential aeration) – factors influencing corrosion – corrosion control methods – sacrificial anode method – impressed current method – corrosion inhibitors – protective coatings – paints – constituents – functions – metallic coatings – electroplating (Cu) and electro less plating (Ni).

UNIT III POLYMERS AND COMPOSITES 9

Polymers: Definition – classification – functionality – polymerization – degree of polymerization – types (addition, condensation, copolymerization) – mechanism (free radical) – plastics – thermoplastics and thermosetting plastics – preparation, properties and uses of individual polymers (PVC, TEFLON, Nylon-6,6, Nylon-6, PET, epoxy resin) – rubber - vulcanization of rubber – applications - Advanced polymeric materials and electronic devices – conducting and semiconducting polymers – liquid crystal properties – dendrimers and their difference from polymers.

Composites: definition – types polymer matrix composites – Fibre Reinforced Polymers – applications – advanced composite materials – physical and chemical properties – applications.

UNIT IV	ENERGY SOURCES AND STORAGE DEVICES	9

Nuclear energy – fission fusion reactions – light water nuclear reactor for power generation – breeder reactor – solar energy conversion – solar cells – wind energy – batteries: alkaline batteries – lead –acid, Ni-Cd, and Li-ion batteries – fuel cells – principles and applications – advantages and disadvantages.

UNIT V	ANALYTICAL TECHNIQUES AND NANOMATERIALS	9

Spectroscopy: Electromagnetic spectrum - Fundamentals of spectroscopy – Instrumentation, working principle and applications of UV-Visible spectrophotometer, Atomic Absorbance Spectrophotometer, Flame photometer.

Nanomaterials: Introduction to nanotechnology in electronics - nanomaterials – fullerernes carbon nanotubes – nanowires – Electronics and mechanical properties -synthesis of nanomaterials – top down and bottom up approach – applications of nanomaterials in electronic devices (Semiconductors, LED & OLED) – electronics and telecommunication – medicines.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1.	apply the knowledge of basic science in identifying, to formulate and to solve the engineering problems.
2.	analyze water borne problems faced in boilers, need for water treatment and various methods and techniques for treating hard water.
3.	understand polymerization reactions and electrochemical reactions and its applications.
4.	acquire Knowledge about energy conversion and chemical reaction taking place in nuclear, solar, wind energy, Batteries, fuel cells and its applications.
5.	obtain in-depth knowledge on various nanomaterials and its applications in electronic devices. Students get basic knowledge on advanced analytical techniques.

TEXT BOOKS:

1.	Vairam S, Kalyani P and Suba Ramesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011
2.	Dara S.S,UmareS.S."Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010

REFERENCES:

1.	*Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010.*
2.	*Rao, C. N. R.; Govindaraj, A. "Nanotubes and Nanowires" United Kingdom: Royal Society of Chemistry, 2005*
3.	*Advanced Polymeric Materials: From Macro- to Nano-Length Scales edited by Sabu Thomas, Nandakumar Kalarikkal, Maciej Jaroszewski, Josmine P. Jose; Apple Academic press, Canada, 2016*
4.	*Jain and jain , 16th editin, "Engineering Chemistry" Dhanpat Rqai Publishing Co.*
5.	*Sivasankar B, "Engineering Chemistry", Tata Mc Graw-Hill Publishing Company Ltd, New Delhi , 2008.*

20ZHS104	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To be able to acquire vocabulary by way of reading skills.
- To be able to write iterative as well as recursive programs.
- To be able to represent data in arrays, strings and structures and manipulate them through a program.
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

UNIT I	VOCABULARY BUILDING	6

1.1 The concept of Word Formation 1.2 Root words from foreign languages and their use in English 1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. 1.4 Synonyms, antonyms, and standard abbreviations

UNIT II	BASIC WRITING SKILLS	6

2.1 Sentence Structures 2.2 Use of phrases and clauses in sentences 2.3 Importance of proper punctuation 2.4 Creating coherence 2.5 Organizing principles of paragraphs in documents 2.6 Techniques for writing precisely

UNIT III	IDENTIFYING COMMON ERRORS IN WRITING	6

3.1 Subject-verb agreement 3.2 Noun-pronoun agreement 3.3 Misplaced modifiers
3.4 Articles 3.5 Prepositions 3.6 Redundancies 3.7 Clichés

UNIT IV	NATURE AND STYLE OF SENSIBLE WRITING	6

4.1 Describing 4.2 Defining 4.3 Classifying 4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

UNIT V	WRITING PRACTICES	6

5.1 Comprehension 5.2 Précis Writing 5.3 Essay Writing

TOTAL: 30 PERIODS

COURSE OUTCOMES

1.	Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2.	Participate effectively in formal and informal conversations; introduce themselves and express their opinions in English.
3.	Comprehend conversations and deliver short talks in English.

4.	Write essays and descriptions of any kind in English.
5.	Prepare reports, graph presentation and Technical writing.
TEXT BOOKS:	
1.	On Writing Well. William Zinsser. Harper Resource Book. 2001
2.	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
3.	Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
REFERENCES:	
1.	*Richards, C. Jack .Interchange Students' Book-2 New Delhi: CUP, 2015.*
2.	*Bailey ,Stephen. Academic Writing: A Practical guide for students .New York: Rutledge, 2011.*
3.	*Seely, John. The Oxford guide to writing & Speaking. New York.1998.*
4.	*Bhatia M.P ,A Handbook of APPLIED GRAMMAR ,M.I Publications, AGRA, Sixth Edition*

20ZES103	ENGINEERING GRAPHICS	L	T	P	C
	(Common to MECH, ECE and CSE)	1	0	4	3

COURSE OBJECTIVES:

•	This course aims to introduce the concept of graphic communication, develop the drawing skills for communicating concepts, ideas and designs of engineering products and to expose them to existing national standards related to technical drawings
•	To draw the projection of simple solids like prisms, pyramids, cylinder etc.
•	To draw the development of surfaces to estimate the sheet metal requirement and to prepare sectional views of solids.
•	To develop skills in three-dimensional visualization of engineering components and to draw isometric views of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – use of drafting instruments – BIS / ISO conventions and specifications – size, layout and folding of drawing sheets – lettering and dimensioning.

UNIT I	PLANE CURVES AND FREE-HAND SKETCHING	6+9

Basic geometrical constructions, curves used in engineering. Conics – construction ofellipse, parabola and hyperbola by eccentricity method – drawing of tangents and normal to the above curves. Visualization concepts and free hand sketching: visualization principles –representation of three-dimensional objects – layout of views- freehand sketching of multiple views from pictorial views of objects.

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACES	6+9

Orthographic projection – Principles-principal planes- First angle projection - Projection of points -Projection of straight lines inclined to both the principal planes - determination of true lengths and true inclinations by rotating line method - traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III	PROJECTION OF SOLIDS	6+9

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

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	6+9

Sectioning of prisms, pyramids, cylinders and cones in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – prisms, pyramids cylinders and cones.

UNIT V	ISOMETRIC PROJECTION AND OVERVIEW OF COMPUTER GRAPHICS	6+9

Principles of isometric projection – isometric scale –isometric projections of simple solids and truncated solids - prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions –Introduction to CAD - The Menu System, Toolbars (Standard, Object

Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD- (CAD – evaluation during CA only)	
Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods	
OUTCOMES:	On completion of this course, students will be able to
1	Familiarize with the fundamentals, standards of Engineering graphics and Perform freehand sketching of multiple views ofbasic geometrical constructions.
2	Draw orthographic projections of points, lines and plane surfaces.
3	Draw projections of solids, sectioned solids and development of surfaces.
4	Visualize and draw isometric views of simple solids.
5	Appreciate the use of computers in drawing and modelling of simple objects.
TEXT BOOKS:	
1.	Natrajan K. V., "**A text book of Engineering Graphics**", Dhanalakshmi Publishers, Chennai, 2016.
2.	Venugopal K. and Prabhu Raja V., "**Engineering Graphics**", New Age International (P) Limited, 2016.
3.	Shah, M. B. and Rana B. C. **"Engineering Drawing and Computer Graphics",** Pearson Education, 2010
REFERENCES:	
1.	*N S Parthasarathy and Vela Murali, "**Engineering Graphics**", Oxford University, Press, New Delhi, 2015.*
2.	*Gopalakrishna K.R., **"Engineering Drawing" (Vol. I&II combined),** Subhas publications, Bangalore, 2014.*
3.	*BasantAgarwal and Agarwal C.M., "**Engineering Drawing**", Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.*
4.	*Luzzader, Warren J. and Duff John M., "**Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production**", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005*
5.	*Bhatt N. D. and Panchal V. M., **"Engineering Drawing**", Charotar Publishing House, 53rd Edition, 2014.*

20ZBS108	CHEMISTRY LABORATORY	L	T	P	C
	(Common to ECE and CSE)	0	0	3	1.5

OBJECTIVES:

- To make students conversant with hands on water parameter analysis.
- To make the student to acquire practical skills in the corrosion in metals.
- To acquaint the students with the determination of molecular weight of a polymer by Ostwald viscometer.
- To make the student acquire practical skills in analytical instruments.

LIST OF EXPERIMENTS:

1. Determination of total hardness of given water sample by EDTA method.
2. Determination of alkalinity in given water sample.
3. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
4. Conductometric titration using mixture of acids and strong base.
5. Determination of strength of in given hydrochloric acid using pH meter.
6. Estimation of sodium present in water using flame photometer.
7. Estimation of Zn present in effluent using Atomic Absorption Spectroscopy (AAS)
8. Corrosion experiment – weight loss method
9. Estimation of iron content of the given solution using potentiometer meter.
10. Estimation of iron content of the given sample using Spectro photometer (thiocyanate method).

Total: 45 Periods

COURSE OUTCOMES

1.	The students will be outfitted with hands-on knowledge in the qualitative and quantitative chemical analysis of water quality related parameters, corrosion studies, heavy metal analysis, etc.

REFERENCES:

1.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
2.	Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
3.	Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.
4.	Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.

(Note: A minimum of SIX experiments shall be offered)
List of equipment for a batch of 30 students

1. Flame photometer - 5 nos
2. Weighing balance - 5 nos
3. Conductivity meter; Potentiometer; pH meter- 9 nos each.
4. Ostwald viscometer - 30 nos
5. Atomic Absorption Spectrophotometer - 1 no.

Common apparatus: Pipette, Burette, Burette stand, Standard volumetric flask, funnel, Conical flask, porcelain tiles, dropper, reagent bottles, glass rod, beaker, wash bottle, test tube (30 nos each)

20ZHS109	COMMUNICATION ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop their communicative competency in English with specific reference to their speaking and listening.
- To enhance their ability to communicate effectively in interviews.
- To strengthen their prospects of success in competitive examinations.
- To Strengthen a good command over of the language proficiency.
- To comprehend a different type of accent and use them in their communication

UNIT I	PRONUNCIATION PRACTICE	6

Verbal Ability, Articulation of sounds- Intonation-Stress and Rhythm-Conversation practice-listening Various lectures

UNIT II	COMMUNICATION AT WORK PLACE	6

Creative writing. Writing job applications - cover letter- resume- e-mails- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III	ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS	6

International English Language Testing System (IELTS)- Test of English as a Foreign Language (TOEFL)- Civil Service (Language related part) –English for competitive examinations

UNIT IV	INTERVIEW SKILLS	6

Different types of Interview format- answering questions- offering information- mock interviews- Body languages.

UNIT V	SOFT SKILLS	6

Motivation- emotional intelligence-Multiple intelligences- managing changes- time management- leadership straits- team work- career planning- creative and critical thinking

TOTAL	30 Periods

COURSE OUTCOMES:

1.	Face interviews, group discussions and other language parameters in the job market
2.	Write any competitive examinations which cover language part in it.
3.	Take part in any English conversations of any kind in English. Flawlessly without fear and shyness.
4.	Write articles for newspapers and magazines or any write-up in English without grammar mistakes.
5.	Come out with leadership qualities, team work and career planning and will also possess critical and creative thinking.

TEXT BOOKS:	
1.	Communication Skills for Engineers and Scientists, PHI Learning PVT.LTD, Delhi, 2014.
2.	Communication Skills and Soft Skills An Integrated Approach, Dorling Kindersley (INDIA) PVT.LTD, New Delhi, 2012.
3.	Soft Skills, MJP Publishers, Chennai, 2010.
REFERENCES:	
1.	*Craven, Miles. Listening Extra-A resource book of multi-level skills activities. Cambridge University Press, 2004.*
2.	*Seely, John. The Oxford guide to writing & Speaking. New Delhi: Oxford University Press,20*
3.	*Comfort, Jeremy, et al. Speaking Effectively: Developing speaking skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.*
4.	*Dutt P. Kiranmai and RajeevanGeetha. Basic Communication Skills, Foundation Books:2013*

20LES110	WORKSHOP PRACTICES	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:

•	To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint
•	To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

LIST OF EXPERIMENTS:

1. Introduction to use of tools and equipment in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, Butt joint and T-joint
5. Preparation of Sand mold for cube, conical bush, pipes and V pulley
6. Fabrication of parts like tray, frustum of cone and square box in sheet metal
7. Electrical wiring – simple house wiring
8. Plumbing
9. CNC Machines demonstration and lecture on working principle.
10. Additive manufacturing demonstration and lecture on working principle.

Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods

COURSE OUTCOMES:	on completion of this course, students will be able to
1	Use tools and equipment used in Carpentry, Welding, Foundry and Sheet metal.
2.	Make half lap joint dovetail joint in carpentry and welded lap joint, butt joint and T-joint
3	Prepare sand mould for cube, conical bush, pipes and V pulley.
4	Fabricate parts like tray, frustum of cone and square box in sheet metal
5	Carry out minor works/repair related to electrical wiring and plumbing.

SECOND SEMESTER

20ZBS201	ENGINEERING MATHEMATICS- II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- vector calculus and their uses in various field theoretic subjects.
- higher order and special type of linear differential equations and methods to find solutions
- Laplace transforms and properties and their applications in engineering
- construction of analytic functions and concepts of concepts of conformal mapping, complex integration and series solutions

UNIT I	VECTOR CALCULUS	9+3

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green‘s theorem in a plane, Gauss divergence theorem and Stokes‘ theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

UNIT II	ORDINARY DIFFERENTIAL EQUATIONS	9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy ‘s and Legendre ‘s linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT III	LAPLACE TRANSFORMS	9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV	ANALYTIC FUNCTIONS	9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V	COMPLEX INTEGRATION	9+3
Complex integration – Statement and applications of Cauchy ‘s integral theorem and Cauchy‘s integral formula – Taylor‘s and Laurent‘s series expansions – Singular points – Residues – Cauchy‘s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).		
		TOTAL: 60 PERIODS

COURSE OUTCOMES	
1.	solve problems on vector calculus and to apply them in any other field theory related subjects
2.	solve differential equations and will be exposed to their applications in various fields of engineering
3.	solve problems on Laplace transforms and will be able to use Laplace transform in finding solutions of differential and integral equations and other engineering applications
4.	solve complex integration problems and will be exposed to various applications of analytic functions and conformal mapping in engineering

TEXT BOOKS:	
1.	Bali N. P and Manish Goyal, “A Text book of Engineering Mathematics”, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2.	Grewal. B.S, “Higher Engineering Mathematics”, 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:	
1.	*Dass, H.K., and Er. Rajnish Verma, “Higher Engineering Mathematics”, S. Chand Private Ltd., 2011.*
2.	*Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2012.*
3.	*Peter V. O‘Neil, “Advanced Engineering Mathematics”, 7th Edition, Cengage learning, 2012.*
4.	*Ramana B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 2008.*
5.	*Sivarama Krishna Das P. and Rukmangadachari E., “Engineering Mathematics”, Volume II, Second Edition, PEARSON Publishing, 2011.*

20ZBS202	PHYSICS OF SEMICONDUCTOR DEVICES	L	T	P	C
	COMMON TO CSE, ECE & EEE	3	0	0	3

OBJECTIVES:

- To learn about the fundamentals of electronic materials and their properties
- To understand about band gap and charge carriers in semiconducting materials
- To learn about transport phenomenon and optical excitation in semiconducting materials
- To know about low dimensional semiconducting materials
- To understand about principle and working of semiconductor devices

UNIT-I	ELECTRONIC MATERIALS	9

Free electron theory, density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, direct and indirect band gaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, occupation probability, Fermi level, effective mass, phonons.

UNIT-II	SEMICONDUCTORS: ENERGY BAND AND CHARGE CARRIERS	9

Energy bands in semiconductors, types of semiconductors, Charge carriers, Intrinsic and extrinsic materials - Carrier concentration: Fermi level, electron and hole concentration equilibrium, Temperature dependence of carrier concentration, compensation and charge neutrality - Conductivity and mobility, effect of temperature, doping and high electric field.

UNIT-III	CARRIER TRANSPORT AND OPTICAL EXCITATION IN SEMICONDUCTOR	9

Carrier transport: Drift transport: Drift current density, mobility effect, velocity-electric field relations - Diffusion transport: Diffusion of carriers, Einstein relation, Continuity equation, carrier injection, diffusion length.

Optical excitation: Optical absorption, carrier generation, Carrier life time, diffusion length and photo conductivity, Direct and indirect recombination and trapping, Excitons, photoconductive devices.

UNIT- IV	THE P-N JUNCTION DIODE	9

Basic structure of the p-n junction and contact potential, Space charge width, reverse and forward bias, capacitance of p-n junction, Zener and avalanche breakdown in p-n junctions, Zener diode: characteristics and its application (Regulator). Semiconductor heterojunction and metal-semiconductor: Schottky barriers diode, tunnel diode, light emitting diode.

UNIT-V	TRANSISTORS	9

BJT: Structure, basic principle of operation, input and output characteristics of CE, CB and CC configuration – FET: JFET- Principle of operation, pinch off and saturation, gate control, I-V

characteristics – MOSFET- Structure, principle of operation, input and output characteristics of CS, CD and CG configuration – SCR: Structure, principle of operation and its characteristics.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES	
At the end of the course, the student will be able	
1.	To understand fundamentals of electronic materials and their properties.
2.	To explain about the origin of band gap in semiconductors.
3.	To describe about charge transport and optical excitation phenomenon.
4.	To understand about p-n junction semiconductor diodes
5.	To understand about the principal and working of semiconductor transistors
TEXT BOOKS:	
1.	*P.Mani, "Physics for Electronics Engineering", Shri Dhanam Publishers, 2020.*
2.	*S. Murugavel, G. Senthil Kumar, "Physics for Electronics Engineering", VRB publishers, 2020*
3.	*A. Marikani, "Engineering Physics", PHI Learning Pvt., India, 2009.*
4.	*S. Mani Naidu, "Applied Physics", Pearson Publisher, India, 2010.*
REFERENCES:	
1.	*M. Balkanski and R.F. Wallis, "Semiconductor Physics and Applications", Oxford University Press, First Published 2000.*
2.	*Donald A. Neamen, "Semiconductor Physics and Devices: Basic Principles", McGraw-Hill Higher Education, Third Edition, 2003.*
3.	*S.M. Sze and Kwok K. Ng, "Physics of Semiconductor Devices", Wiley-Interscience, Third Edition, 2007.*
4.	*V.K. Metha and Rohit Metha, "Principles of Electronics", Chand & Co, 2014.*

20ZES203	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the organization of a digital computer
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION **8**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm –Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS **10**

Problem formulation – Problem Solving - Introduction to 'C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference –Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNION **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Know the various number systems and their conversion.
2. Write simple programs in C.
3. Write programs based on arrays.
4. Write programs using functions and pointers concepts
5. Write programs using Structures and Files.

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

2.	Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition,Oxford University Press, 2009.
3.	Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:

1.	*Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill,2006.*
2.	*Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.*
3.	*Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, PearsonEducation, 2006.*

Course Articulation Matrix:

	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2						1	1	2	3	
CO2	2	2	1	1	2						1	1	2	3	
CO3	2	2	2	2	1						1	1	2	3	
CO4	2	2	2	2							1	1	2	3	
CO5	2	2	2	2							1	1	2	3	

(1- Low, 2- Moderate, 3-High)

20LPC204	CIRCUIT THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of DC/ AC circuits and analyze them using network Theorems &Topology.
- To study the transient response of the circuits and the concepts of resonance and coupled circuits.
- To learn about the two port networks and characterize them using parameters

UNIT I	INTRODUCTION	9

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices– Trees –Cutsets - Fundamental cutsets - Cutset matrix – Tie sets - Link currents and Tie set schedules -Twig voltages and Cutset schedules, Duality and dual networks.

UNIT II	NETWORK THEOREMS	9

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem, application of Network theorems- Network reduction: voltage and current division, source transformation – star delta conversion.

UNIT III	RESONANCE AND COUPLED CIRCUITS	9

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor -Selectivity. Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multiwinding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.

UNIT IV	TRANSIENT ANALYSIS	9

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

UNIT V	TWO PORT NETWORKS	9

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the completion of the course students will have the
1.	ability to analyse the DC/AC circuits using network topology.
2.	Ability to analyse the DC/AC circuits using network theorems.
3.	an understanding of the concepts of resonance and coupled circuits.
4.	exposure to transient and steady state response of electric circuits.
5.	knowledge on two port networks and their parameter characterization.
TEXT BOOKS:	
1.	William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, ―"Engineering Circuit Analysis" , McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.
2.	Joseph Edminister and Mahmood Nahvi, ―"Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.
3.	Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, 2007.
REFERENCES:	
1.	*Charles K. Alexander, Mathew N.O. Sadiku, ―Fundamentals of Electric Circuits‖, Fifth Edition,McGraw Hill, 9th Reprint 2015*
2.	*A.Bruce Carlson, ―Cicuits: Engineering Concepts and Analysis of Linear Electric Circuits",Cengage Learning, India Edition 2nd Indian Reprint 2009*
3.	*Allan H.Robbins, Wilhelm C.Miller, ―Circuit Analysis Theory and Practice‖, Cengage Learning,Fifth Edition, 1st Indian Reprint 2013.*
4.	*Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.*

COURSE ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
CO2	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
CO4	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
CO5	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-
20LPC204	2	3	3	1	-	-	-	-	-	-	-	-	3	2	-

1-LOW 2- MODERATE (MEDIUM) 3- HIGH

	CONSTITUTION OF INDIA	L	T	P	C
Common to MECH, EEE, ECE and CSE Branches		1	0	0	0

OBJECTIVES

To provide understanding of basic concepts of Indian Constitution and various organs created by the constitution including their functions.

UNIT – I: INTRODUCTION

Constitution' Definition and Classification -Constitutional Organs - Indian Constitution: Sources and constitutional history, Salient features of Indian Constitution - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy Rule of Law - Separation of powers Constitution - Doctrine of Basic Structure.

UNIT-II: UNION GOVERNMENT & STATE GOVERNMENT AND THEIR ADMINISTRATION

Distribution of Powers between Center and States Structure of the Indian Union: Federalism, Centre- State -relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha.

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT-III: LOCAL ADMINISTRATION & ELECTION COMMISSION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayatiraj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy Emergency Provisions - Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

COURSE OUTCOME

On completion of the course, the student will be able to understand the constitutional setting of the India and have awareness about the basic human rights in India and responsibilities as a citizen.

Recommended References:

1. V.N. Shukla, Constitution of India
2. M.P. Jain – Indian Constitutional Law.
3.H.M.Seervai : Constitution of India
4.D.D.Basu: Shorter Constitution of India
5.Kagzi : Indian Constitution
6.Pylee : The History of Indian Constitution

20ZES209	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be familiar with programming in C.
- Be exposed to Decision making, Looping constructs.
- Learn to use Arrays, strings, functions.
- Implement the concepts of structure, Union and file organization.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem-solving using decision making and looping.
6. Simple programming for one dimensional and two-dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. a. Programs with Pointers.
   b. Program using Recursive Function.
10. Program using structures and unions.

TOTAL: 45 PERIODS

OUTCOMES: On completion of this course, students will be able to

1. Apply good programming design methods for program development.
2. Design and implement C programs for simple applications.
3. Write C programs, which involve decision making and arrays and strings.
4. Develop programs using functions and pointers.
5. Develop programs using structures and unions.

REFERENCES:

1. *Herbert Schildt, "C - The Complete Reference", Tata McGraw Hill Publishing Company, New Delhi, 2010.*

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1						1	1	2	3	
CO2	3	2	1	1	1						1	1	2	3	
CO3	2	2	2	2	1						1	1	2	3	
CO4	2	2	2	2	1						1	1	2	3	
CO5	2	2	2	2	1						1	1	2	3	

(1- Low, 2- Moderate, 3-High)

20ZBS208	PHYSICS LABORATORY	L	T	P	C
	(Common to ECE & CSE)	0	0	3	1.5

OBJECTIVES

•	To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids

LIST OF EXPERIMENTS: PHYSICS LABORATORY (ANY 5 EXPERIMENTS)

1.	Determination of rigidity modulus: Torsion Pendulum
2.	Determination of Young's modulus by non-uniform bending method
3.	(a) Determination of wave length and particle size using LASER (b) Determination of acceptance angle in an optical fibre
4.	Determination of thermal conductivity of a bad conductor – Lee's Disc method
5.	Determination of velocity of sound and compressibility of fluid – Ultrasonic interferometer
6.	Determination of wavelength of mercury spectrum – Spectrometer grating
7.	Determination of band gap of a semiconductor

TOTAL: 45 PERIODS

COURSE OUTCOMES

1.	After the course, the student will be able to apply principles of elasticity, optical and thermal properties for engineering applications

REFERENCE:

1.	*R. Bakkiyaraj and A. Anandakumar, Physics Laboratory Manual, 2020*

20LPC210	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To analyze experimentally the characteristics of diodes, BJT ‘s and FET ‘s.
- To verify practically the response of various special purpose electron devices.
- To construct and simulate various electronic circuits using PSPICE/multisim.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode.
2. Characteristics of Zener diode & its application as regulator.
3. Input-output Characteristics of common emitter configuration.
4. Input-output Characteristics of common base configuration.
5. FET Characteristics.
6. SCR Characteristics.
7. Verification of Thevenin ‘s & Norton ‘s theorem.
8. Verification of KVL &KCL.
9. Verification of Super Position Theorem.
10. Verification of Maximum Power Transfer & Reciprocity theorem.
11. Determination of Resonance Frequency of Series & Parallel RLC Circuits.
12. Transient analysis of RL and RC circuits.
13. PSPICE/Multisim simulation of the above experiments.

TOTAL: 30 PERIODS

COURSE OUTCOMES	Upon completion of the course, the students will have the ability to
1.	Analyze the characteristics of various diodes.
2.	Analyze the characteristics of BJT and FET transistors.
3.	Verify Thevenin, Norton, KVL, KCL, Maximum Power Transfer and Super Position Theorems.
4.	Determine and verify resonant frequency of tuning circuits.
5.	Analyze various electronic circuits using PSPICE/multisim simulator.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2_	1_	1	3	_-	-_	_	2	_	_	2	3	2	1
CO2	2	2	2	1	3	_-	-_	_	2	_	_	2	2	3	2
CO3	2	2	1	1	3	_	_	_	2	_	_	2	3	2	2
CO4	3	2	2	1	3	-_	_-	-_	2	_	_	2	2	3	1
CO5	3	2	2	1	3	_-	_-	_-	2	_	_	2	2	3	1
20LPC210	3	2	2	1	3	_	_	_	2	_	_	2	2	3	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

THIRD SEMESTER

20ZBS301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	9+3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II	FOURIER SERIES	9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	9+3

Classification of PDE – Method of separation of variables - Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges).

UNIT IV	FOURIER TRANSFORMS	9+3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	9+3
Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES	
1.	The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:	
1.	Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 2016
2.	Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2017.
3.	Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd., 1998.

REFERENCES:	
1.	*Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt Ltd, 9th Edition 2016.*
2.	*Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.*
3.	*Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.*
4.	*Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.*
5.	*Ray Wylie C and Barrett. L.C, "Advanced Engineering Mathematics", 6th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.*
6.	*Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.*

20LPC302	ELECTRONIC CIRCUITS - I	L	T	P	C
		3	0	0	3

UNIT I	BIASING OF BJT AND FET	9

DC Load line, operating point, Various biasing methods for BJT-Design-Stability-Bias compensation, Thermal stability, Design of biasing for JFET, Design of biasing for MOSFET

UNIT II	BJT AND FET AMPLIFIERS	9

Small signal Analysis of Common Emitter- AC Load line, Voltage swing limitations, Common collector and common base amplifiers – Differential amplifiers- CMRR- Darlington Amplifier- Bootstrap technique, Small signal Analysis of MOSFET and JFET Common source amplifier.

UNIT III	FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS	9

Low frequency analysis and Miller effect, High frequency analysis of CE and MOSFET CS amplifier, Short circuit current gain, cut off frequency – fα and fβ unity gain and Determination of bandwidth of single stage and multistage amplifiers.

UNIT IV	LARGE SIGNAL AMPLIFIERS	9

Classification of amplifiers – Class A large signal amplifiers – Transformer coupled class A audio power amplifier – Efficiency of Class A amplifiers – Class B amplifier – Efficiency – push-pull amplifier – Distortion in amplifiers – Complementary – Symmetry (class B) push-pull amplifier – Class AB amplifier - Class C amplifier – Class D amplifier.

UNIT V	FEEDBACK AMPLIFIERS	9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon completion of the course students will be able to
1.	Design circuits with different transistor biasing techniques.
2.	Design simple amplifier circuits.
3.	Analyse the frequency response of transistors.

4.	Design and analyse large signal amplifiers.
5.	Design and analyse feedback amplifiers.
TEXT BOOKS:	
1.	Donald.A. Neamen, Electronic Circuit Analysis and Design –2nd Edition, Tata Mc Graw Hill, 2009.
2.	Millman.J. and Halkias C.C, "Integrated Electronics", Mc Graw Hill, 2001.
3.	Adel.S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 6th Edition, Oxford University Press, 2010.
REFERENCES:	
1.	*David A., "Bell Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010*
2.	*Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata Mc Graw Hill, 2007.*
3.	*S Salivahanan, N Suresh Kumar, "Electronic Devices and Circuits", Third Edition Graw Hill,2012*
4.	*D.Schilling and C.Belove, "Electronic Circuits", 3rd Edition, Mc Graw Hill, 1989.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	_	_	_	_	_	_	_	_	_	_	3	3	3	1
CO2	3	2	3	2	_	_	_	_	_	_	_	2	3	3	1
CO3	3	3	2	2	_	_	_	_	_	_	_	2	2	2	2
CO4	3	3	2	2	_	_	_	_	_	_	_	2	3	3	2
CO5	3	_	_	_	_	_	_	_	_	_	_	2	3	3	1
20LPC302	3	3	2	2	_	_	_	_	_	_	_	2	2	3	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPC303	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space.
- To understand the concepts of electric and magnetic fields among different materials and boundary conditions.
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations

UNIT I	STATIC ELECTRIC FIELD	9

Vector Algebra, Coordinate Systems, Vector differential operator, Gradient, Divergence, Curl, Divergence theorem, Stokes theorem, Coulombs law, Electric field intensity, Point, Line, Surface and Volume charge distributions, Electric flux density, Gauss law and its applications, Gauss divergence theorem, Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT II	CONDUCTORS AND DIELECTRICS	9

Conductors and dielectrics in Static Electric Field, Current and current density, Continuity equation, Polarization, Boundary conditions, Method of images, Resistance of a conductor, Capacitance, Parallel plate, Coaxial and Spherical capacitors, Boundary conditions for perfect dielectric materials, Poisson's equation, Laplace's equation, Solution of Laplace equation, Application of Poisson's and Laplace's equations.

UNIT III	STATIC MAGNETIC FIELDS	9

Biot -Savart Law, Magnetic field Intensity, Estimation of Magnetic field Intensity for straight and circular conductors, Ampere's Circuital Law, Point form of Ampere's Circuital Law, Stokes theorem, Magnetic flux and magnetic flux density, The Scalar and Vector Magnetic potentials, Derivation of Steady magnetic field Laws.

UNIT IV	MAGNETIC FORCES AND MATERIALS	9

Force on a moving charge, Force on a differential current element, Force between current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions involving magnetic fields, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance, Basic expressions for self and mutual inductances, Inductance evaluation for solenoid, toroid, coaxial cables and transmission lines, Energy stored in Magnetic fields.

UNIT V	TIME VARYING FIELDS AND MAXWELL'S EQUATIONS	9
Fundamental relations for Electrostatic and Magnetostatic fields, Faraday's law for Electromagnetic induction, Transformers, Motional Electromotive forces, Differential form of Maxwell's equations, Integral form of Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and their solutions, Poynting's theorem, Time harmonic fields, Electromagnetic Spectrum.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon Completion of the course, the students will have
1.	The Ability to analyse electric fields due to different sources.
2.	The Ability to explain the properties of different types of materials in electric fields.
3.	The Ability to analyse magnetic fields due to different sources.
4.	The knowledge on the properties of different types of materials in magnetic fields.
5.	An exposure to the characteristics of electromagnetic fields.

TEXT BOOKS:	
1.	William H.Hayt and John A.Buck., "Engineering Electromagnetics", Tata McGraw-Hill Publishing, 2008
2.	Sadiku MH, "Principles of Electromagnetics", Oxford University Press Inc, New Delhi, 2009
3.	David K Cheng, "Field and Wave Electromagnetics", Pearson Education Inc, Delhi, 2004.

REFERENCES:	
1.	*G.S.N.Raju, "Electromagnetic Fields", Pearson Education India, 2014*
2.	*John D Kraus and Daniel A Fleisch, "Electromagnetics with Applications", Mc Graw Hill Book Co, 2005.*
3.	*Karl E Longman and Sava V Savov, "Fundamentals of Electromagnetics", Prentice Hall of India, New Delhi, 2006.*
4.	*Ashutosh Pramanic, "Electromagnetism", Prentice Hall of India, New Delhi, 2006.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	-	-	-	-	-	-	2	3	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	2	3	-	1
CO3	3	3	1	1	-	-	-	-	-	-	-	2	3	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	2	3	-	1
CO5	3	3	1	1	-	-	-	-	-	-	-	2	3	-	1
20LPC303	3	3	1	1	-	-	-	-	-	-	-	2	3	-	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPC304	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the continuous/Discrete time signals/systems.
- Exposure to continuous time signals/systems analysis using Fourier/Laplace transform
- Exposure to discrete time signals/systems analysis using DTFT/Z transform

UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9

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

UNIT II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9

Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties.

UNIT III	LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS	9

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis of CT systems.

UNIT IV	ANALYSIS OF DISCRETE TIME SIGNALS	9

Baseband Sampling - DTFT – Properties of DTFT - Z Transform – Properties of Z Transform.

UNIT V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	9

Difference Equations-Block diagram representation-Impulse response - Convolution sum-Discrete Fourier and Z Transform Analysis of Recursive & Non-Recursive systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon completion of this course, students will have the
1.	Exposure to the continuous/discrete time signals/systems and their classification and properties
2.	Ability to analyse continuous time signals using Fourier/Laplace transforms
3.	Ability to analyse continuous time systems using Fourier/Laplace transforms

4.	Ability to analyse discrete time signals using DTFT/Z transforms
5.	Ability to analyse discrete time systems using DTFT/Z transforms
TEXT BOOKS:	
1.	Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.
2.	Simon Haykin, Barry Van Veen., "Signals & Systems". John Wiley &Sons (ASIA) Pvt Ltd, 1999.
3.	B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
REFERENCES:	
1.	*R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.*
2.	*P.Ramesh Babu,R.Anandanatarajan,"Signals and Systems", Fifth Edition, SciTech Publications*
3.	*H P HSU, "Signals and Systems", 2nd edition, Mc.Hill.education, 2017*
4.	*M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2007.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2		-	-	-	-	-	-	-	3	2	-
CO2	3	2	2	2	2	-	-	-	2	-	-	2	3	1	-
CO3	3	2	2	-	2	-	-	-	2	-	-	2	3	1	-
CO4	3	2	2	-	2	-	-	-	2	-	-	2	3	2	-
CO5	3	3	3	-	2	-	-	-	2	-	-	2	3	2	-
20LPC304	3	2	2	2	2	-	-	-	2	-	-	2	3	2	-

1-LOW 2-MODERATE(MEDIUM) 3-HIGH

20LES305	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING LANGUAGE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To be familiar with the object-oriented programming concepts
- To understand the concepts of inheritance, polymorphism and overloading
- To impart the basic concepts of data structures and algorithms
- To be familiar with the non-Linear Data Structures concepts
- To understand concepts of searching and sorting techniques

UNIT I	BASIC CONCEPTS OF OOPS	9

Principles of Object-Oriented Programming - Beginning with C++ - Tokens, Expressions, Control Structures – Functions in C++ - Classes and Objects – Constructors and Destructors

UNIT II	OVERLOADING, INHERITANCE AND POLYMORPHISM	9

Operator overloading and function overloading - Inheritance: extending classes - Pointers, virtual functions, polymorphism – Manipulating Strings.

UNIT III	LINEAR DATA STRUCTURES	9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists – Stack ADT – Applications: Infix to Postfix, Evaluating arithmetic expressions - Queue ADT.

UNIT IV	NON-LINEAR DATA STRUCTURES	9

Trees – Binary Trees – Binary tree representation and traversals – Binary Search Tree - Graph and its representations – Graph Traversals – Breadth-first search – Depth-first search - Connected components.

UNIT V	SORTING AND SEARCHING	9

Insertion sort – Merge sort – Quick sort – Radix sort – shell sort- Bubble sort – Selection sort –Linear search – Binary Search.

TOTAL: 45 PERIODS

OUTCOMES:

- Explain the concepts of Object-oriented programming.
- Write simple applications using C++.
- Discuss the different methods of organizing large amount of data.

TEXT BOOKS:	
1.	E.Balagurusamy, "Programming in C++", 4th Edition. (Unit I & II)
2.	M. A. Weiss, "Datastructures using C++", 3rd Edition, Addition Wesley. (Unit III, IV, V)
REFERENCES:	
1.	*B.Trivedi, "Programming with ANSI C++:A Step-By-Step approach", Oxford University Press, 2010.*
2.	*Goodrich, Michael. T, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++", 7th Edition, Wiley, 2004.*

Course Articulation Matrix:

	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1					1	1	3	2	
CO2	3	3	2	2							1	1	2	3	
CO3	2	2	2	2	2						1	1	2	3	

(1- Low, 2- Moderate, 3-High)

20ZMC306	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		1	0	0	0

OBJECTIVES:

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I **ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** **7**

concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- types of ecosystem (forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - energy flow in the ecosystem – ecological succession processes – types – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds. **Field study of simple ecosystems – pond, river, hill slopes, etc**.

UNIT II **ENVIRONMENTAL POLLUTION** **3**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– solid waste management: causes, effects and control measures.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III **NATURAL RESOURCES** **5**

Forest resources: Use and over-exploitation, deforestation – Water resources: Use and overutilization of surface and ground water– Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems– Energy resources: renewable and non-renewable energy sources, use of alternate energy sources.– Land resources- land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources.
Field study of local area to document environmental assets – river / forest / grassland / hill

TOTAL : 15 PERIODS

COURSE OUTCOMES

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

1. Ability to apply the knowledge of environmental science in identifying, to formulate and to solve the environmental problems.
2. Public awareness of environmental function is at infant stage.
3. Ignorance and incomplete knowledge has led to misconceptions. Obtaining knowledge about natural recourses and their functions will create awareness in conserving various natural resources.

TEXT BOOKS:

1. *Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.*
2. *Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.*

REFERENCES:

1. *Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.*
2. *Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.*

20LES307	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce DC Machines
- To study the Basics of Transformer
- To introduce Induction Machines
- To understand the concepts of Alternators and Special machines
- To introduce different Electrical Measuring Instruments.

UNIT I	DC MACHINES	9

Introduction –DC generators- Constructional Features–Principle of operation- EMF Equation – Types and Characteristics of DC generators –DC motors - Principle of Operation–Types and Characteristics of DC motors –Starting and Speed Control – Losses and Efficiency – Applications.

UNIT II	TRANSFORMERS	9

Introduction - Single phase transformer construction and principle of operation –Types-EMF equation–No load and Load characteristics – Equivalent Circuit –Voltage Regulation – Losses-Efficiency –OC and SC tests –Autotransformers –Three Phase Transformers – Applications.

UNIT III	INDUCTION MACHINES	9

Principle of operation of three-phase induction motors – Construction –Types – Torque Slip Characteristics –Equivalent circuit– Starting and Speed Control–Single phase Induction motors: Construction– Double revolving field theory –Types– Applications.

UNIT IV	SYNCHRONOUS AND SPECIAL MACHINES	9

Alternator-Constructional details–working principle–EMF Equation – Voltage regulation by EMF and MMF methods. Synchronous motor: Working principle - Starting methods – Torque equation – Characteristics. Special Machines: Stepper Motor – Brushless DC Motor - Reluctance Motor – Universal Motor.

UNIT V	ELECTRICAL INSTRUMENTS AND MEASUREMENTS	9
Absolute and Secondary Instruments-Electrical Principle of operation-Standards and errors-Essentials of indicating instruments- Moving Coil and Moving Iron Ammeters and Voltmeters– Wattmeter and Energy meter–Measurement of R, L and C parameters: Wheatstone, Anderson, Schering and Wien bridges –Transducers – Classification of Transducers: Resistive, Inductive, Capacitive, piezoelectric, photoelectric and Hall effect.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES	At the end of the course, students able to
1.	Choose the appropriate DC motor and generator based on their performance characteristics.
2.	Understand the functions and operations of transformer
3.	Choose an appropriate induction motor based on their performance characteristics.
4.	Select appropriately a special machine for an Industrial application.
5.	Choose an appropriate measuring instruments for a given application to measure the unknown parameter.

TEXT BOOKS:	
1.	D.P. Kothari and I.J.Nagarath, ―"Basic Electrical and Electronics Engineering", McGraw HillEducation (India) Private Limited, Third Reprint, 2016.
2.	B.L.Theraja and A.K.Theraja,"A Text Book of Electrical Technology", Vol-I and II, S. Chand &Co. 2014.
3.	Toro,"Electrical Engineering Fundamental", Pearson Education, New Delhi, 2015.

REFERENCES:	
1.	*Rajendra Prasad ,"Fundamentals of Electrical engineering", Prentice Hall of India,2006*
2.	*S.K.Bhattacharya ―"Basic Electrical and Electronics Engineering", Pearson India, 2011.*
3.	*E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.*
4.	*A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2010.*

20LES308	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING LANGUAGE LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Understand the fundamentals of object-oriented concepts.
- Be able to write a C++ program to solve various problems.
- Be able to choose appropriate data structures to solve the problems.
- To develop skills to design and analyse simple linear and nonlinear data structures
- To Gain knowledge in practical applications of data structures

LIST OF EXPERIMENTS

1. Programs on C++ basic concepts.
2. Program constructors, constructor overloading, destructors
3. Programs on Function overloading, Operator overloading.
4. Program to implement single, multiple, multilevel, hybrid and hierarchical inheritance.
5. Programs on pointers.
6. Programs on string manipulation
7. Program on singly linked list using array-based implementation and list implementation
8. Program for Doubly linked list using array-based implementation and list implementation
9. Program to convert infix to postfix notation
10. Program to evaluate arithmetic expression.
11. Program for Linear queue using array and list-based implementation
12. Program to implement binary search tree.
13. Program to implement merge sort, quick sort, insertion sort, shell sort, selection sort, radix sort.
14. Program to implement linear search and binary search.

TOTAL: 30 PERIODS

OUTCOMES:

1.	Know the concept of C++ and pointers.
2.	Implement Arrays, Linked list and searching algorithm.

REFERENCES:

1.	*S. Arora, "Practical world of C++", Dhanpat Rai & CO (Pvt)Ltd.*
2.	*Spoken-tutorial.org.*

Course Articulation Matrix:															
Program Outcomes													Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1							1	1	2	1	
CO2	3	3	2	2	2	2					1	1	2	3	
(1- Low, 2- Moderate, 3-High)															

20LPC309	ELECTRONIC CIRCUITS - I LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

To analyse experimentally the characteristics of amplifiers.

To verify practically the frequency response of various BJT and FET amplifiers.

To construct and simulate various electronic circuits using PSPICE/Multisim.

LIST OF EXPERIMENTS

Design, Simulation & implementation of the below

USING DISCRETE COMPONENTS

1. Half Wave and Full Wave Rectifiers.
2. Filters and Power supplies.
3. Differential Amplifiers- Transfer characteristic, CMRR Measurement
4. Darlington Amplifier
5. Frequency Response of CE amplifier
6. Frequency Response of CS amplifiers.
7. Class A Power Amplifiers
8. Class B Power Amplifiers
9. Class AB Power Amplifiers.
10. Feedback amplifiers

	TOTAL :30 PERIODS

COURSE OUTCOMES	**Upon completion of the course students will be able to**
1.	Design power supply circuits.
2.	Analyze the transfer characteristics in differential amplifier.
3.	Analyze the limitation in bandwidth in amplifiers.
4.	Design power and feedback amplifiers
5.	Simulate amplifiers using SPICE

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	_	_	_	3	2	_	3	3	1	3
CO2	3	2	3	2	2	_	_	_	3	2	_	3	3	1	2
CO3	3	3	3	2	2	_	_	_	3	2	_	3	3	1	2
CO4	3	3	3	2	2	_	_	_	3	2	_	3	3	1	3
CO5	2	2	3	3	2	_	_	_	3	2	_	3	3	1	2
	3	2	3	2	2	_	_	_	3	2	_	3	3	1	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LES310	ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

•	To conduct experiment and evaluate the performance of DC machines
•	To conduct experiment and evaluate the performance of Transformers
•	To conduct experiment and evaluate the performance of Induction motors
•	To conduct experiment and measure the values of passive circuit elements
•	To understand theactive and passive transducers.

LIST OF EXPERIMENTS

1. Characteristics of Separately excited DC generator
2. Characteristics of Self excited DC generator (shunt and series)
3. Speed control of DC Shunt motors
4. Load test on DC motors
5. OC and SC test of Single-phase Transformers
6. Load test on transformer (Single Phase and three phase)
7. Load test of Induction motor (single phase and three phase)
8. Regulation of three phase alternator (EMF and MMF Methods)
9. Measurements of R, L and C using Bridges
10. Study of DC and Induction Motor starters.
11. Study of Transducers.

TOTAL: 30PERIODS

COURSE OUTCOMES	At the end of the course, students able to
1.	Conduct the experiments on DC machines to analyse the performance characteristics
2.	Conduct the experiments on transformer and get the equivalent circuits and Performance characteristics
3.	Conduct the experiments on Induction motor and get its Performance characteristics
4.	Measure the values given passive component with the use of bridge circuit.
5.	Identify and characterize the active and passive transducers.

FOURTH SEMESTER

20ZBS401	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems etc in communication engineering.

UNIT I	RANDOM VARIABLES	9+3

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

UNIT III	RANDOM PROCESSES	9+3

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNIT IV	CORRELATION AND SPECTRAL DENSITIES	9+3

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V	LINEAR SYSTEMS WITH RANDOM INPUTS	9+3

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

	TOTAL: 60 PERIODS

COURSE OUTCOMES	
1.	The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyse the response of random inputs to linear time invariant systems.

TEXT BOOKS:	
1.	Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", 2nd Edition, Academic press (Elsevier), 2014.

2.	Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, New Delhi, 2002.

REFERENCES:

1.	*Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", 3rd Edition, Wiley India Pvt. Ltd., Bangalore, 2014.*
2.	*Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", 4th Edition, Pearson Education, Asia, 2014.*
3.	*Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", 2nd Edition, Academic Press, 2012.*
4.	*Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", 3rd Edition, Tata Mc Graw Hill Edition, New Delhi, 2014.*
5.	*Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3rd Indian Edition, Oxford University Press, New Delhi, 2012.*

20LPC402	ELECTRONIC CIRCUITS - II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To design oscillators and tuned amplifiers.
- To design wave shaping circuits and different multivibrator circuits.
- To understand the linear and non-linear applications of operational amplifiers.

UNIT I	OSCILLATORS	9

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

UNIT II	TUNED AMPLIFIERS	9

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers - Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth–Stagger tuned amplifiers–large signal tuned amplifiers – Class C tuned amplifier – Efficiency and applications of Class C tuned amplifier - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method.

UNIT III	WAVE SHAPING AND MULTIVIBRATOR CIRCUITS	9

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

UNIT IV	OPERATIONAL AMPLIFIER	9

Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, Features of 741 Op-Amp, Modes of Operation - Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT V	OP-AMP, IC-555 & IC 565 APPLICATIONS	9
Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, waveform Generators - Triangular, Sawtooth, Square wave, IC555 Timer - Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL-Block Schematic, Description of Individual locks, Applications. Voltage Controlled Oscillator, PLL and its Applications.		
	TOTAL :45PERIODS	

COURSEOUTCOMES	Upon the course completion, the student will have the ability to
1.	Design RC and LC oscillators
2.	Design and analyse tuned amplifiers
3.	Design Wave shaping circuits and multivibrators.
4.	Design linear and nonlinear applications of OP –AMPS
5.	Design applications using analog multiplier and PLL.

TEXTBOOKS:

1.	Sedra and Smith, ―Micro Electronic Circuits‖; Sixth Edition, Oxford University Press, 2011.
2.	Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 10 Edition, Pearson Education / PHI, 2008
3.	D.RoyChoudhary, SheilB.Jani, Linear Integrated Circuits, II edition, New Age, 2003.

REFERENCES:

1.	*Millman J. and Taub H., "Pulse Digital and Switching Waveforms", TMH, 2000.*
2.	*David A. Bell, ―Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.*
3.	*Millman and Halkias. C., Integrated Electronics, TMH, 2007.*
4.	*Allen mottershed., "Electronic devices and circuits"., PHI-1989.*
5.	*M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 2002.*
6.	*RamakantA.Gayakward, Op-amps and Linear Integrated Circuits, IV edition, Pearson Education, 2003 /PHI.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	1	-	1	2	-	1	1	1	2
CO2	2	2	2	2	1	1	1	-	1	2	-	2	2	1	2
CO3	2	2	2	2	1	1	1	-	1	2	-	2	2	1	2
CO4	2	2	2	2	1	1	1	-	1	2	-	2	2	1	2
CO5	2	2	2	2	1	1	1	-	1	2	-	2	2	1	2
20LPC402	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2

20LPC403	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Objectives

- To learn discrete Fourier transform and its properties
- To know the characteristics of IIR and FIR filters and learn the design of infinite and finite impulse response filters for filtering undesired signals
- To understand Finite word length effects and study the concept of Multirate and adaptive filters

UNIT I	DISCRETE FOURIER TRANSFORM	9

Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in time Algorithms, Decimation in frequency Algorithms

UNIT II	IIR FILTER DESIGN	9

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.

UNIT III	FIR FILTER DESIGN	9

Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window, Bartlett Window, Blackmann Window), Frequency sampling techniques – Finite word length effects in digital Filters: Errors, Limit Cycle, Noise Power Spectrum.

UNIT IV	FINITE WORDLENGTH EFFECTS	9

Fixed point and floating-point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Roundoff noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling

UNIT V	DSP APPLICATIONS	9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Apply DFT for the analysis of digital signals & systems
2.	Design IIR and FIR filters
3.	Characterize finite Word length effect on filters
4.	Design the Multirate Filter
5.	Apply Adaptive Filters to equalization

TEXT BOOKS:	
1.	John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2.	A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCES:	
1.	*Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007.*
2.	*Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.*
3.	*Li Tan, Jean Jiang, "Digital Signal Processing Fundamentals and Applications", 2nd Edition, Academic Press, 2013.*
4.	*Steven W.Smith,"Digital Signal Processing : A Practical Guide for Engineers and Scientists" Demystifying Technology Series, Nownes.*
5.	*A. Nagoorkani, "Digtial Signal Processing ", Second Edition, Tata Mcgraw Hill*

20LPC404	TRANSMISSION LINES AND WAVE GUIDES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the various types of transmission lines and discuss the losses association.
- Realize the impedance transformation, matching of transmission lines and to use the Smith Chart in problem solving.
- To impart the knowledge on filter theories and propagation of electromagnetic waves in waveguides.

UNIT I	TRANSMISSION LINE THEORY	9

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short-circuited lines - reflection factor and reflection loss.

UNIT II	HIGH FREQUENCY TRANSMISSION LINES	9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short-circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT III	IMPEDANCE MATCHING IN HIGH FREQUENCY LINES	9

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT IV	PASSIVE FILTERS	9

Characteristic impedance of symmetrical networks - filter fundamentals, Design of filters: Constant K - Low Pass, High Pass, Band Pass, Band Elimination, m- derived sections - low pass, high pass composite filters

UNIT V	WAVEGUIDES	9

Waves between the parallel planes: Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, Characteristics of TM, TE and TEM waves – Attenuation in parallel plane guides – Wave Impedance.

Rectangular waveguide: TM, TE and TEM waves, Dominant mode-cut-off frequency in waveguides – Impossibility of TEM Waves in waveguide, Characteristics of TM, TE and TEM waves – Attenuation of TE and TM modes in rectangular guides – Wave Impedance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability.
1.	To discuss the propagation of signals through transmission lines and waveguides.
2.	To analyze signal propagation at Radio frequencies.
3.	The knowledge on utilization of smith chart for line parameter and impedance calculations.
4.	To analyze and design a filter in various network.
5.	To explain the radio propagation in guided systems and to evaluate the characteristics of wave guides.

TEXT BOOKS:

1.	John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2010.
2.	E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2006.
3.	A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Education (India) Private Limited; 5th edition, 2015.

REFERENCES:

1.	*Umesh Sinha, "Transmission Lines and Networks", Satya Prakashan, 2010.*
2.	*S. Ramo and J.R. Whinnery, "Fields and Waves in Communication Electronics", 3rdEdition, John Wiley and Sons, 1994.*
3.	*Gottapu Sashibhusana Rao, "Electromagnetic field theory and transmission lines", Wiley series.*
4.	*G.S.N Raju "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005.*
5.	*Philip C. Magnusson, Gerald C. Alexander, Vijai K. Tripathi, Andreas Weisshaar, "Transmission Lines and Wave Propagation", CRC Press.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	1	3	2	2	2
CO2	3	3	3	3	2	2	-	-	-	-	1	3	2	2	2
CO3	3	3	3	3	3	3	-	-	-	-	2	3	2	2	2
CO4	3	3	3	3	3	3	-	-	-	-	2	3	2	2	2
CO5	3	3	3	2	3	3	-	-	-	-	2	3	2	2	2
20LPC404	3	3	3	3	3	3	-	-	-	-	2	3	2	2	2

1-LOW 2-MODERATE(MEDIUM) 3-HIGH

20LPC405	ANALOG COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of various analog modulations and their spectral characteristics.
- To understand the properties of random process
- To know the effect of noise on communication systems

UNIT I	AMPLITUDE MODULATION	9

Generation and detection of AM wave-spectra-DSBSC, Hilbert Transform, Pre-envelope & complex envelope - SSB and VSB –comparison -Super heterodyne Receiver.

UNIT II	ANGLE MODULATION	9

Phase and frequency modulation-Narrow Band and Wide band FM - Spectrum - FM modulation and demodulation – FM Discriminator- PLL as FM Demodulator - Transmission bandwidth.

UNIT III	RANDOM PROCESS	9

Random variables, Central limit Theorem, Random Process, Stationary Processes, Mean, Correlation& Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process Through a LTI filter.

UNIT IV	NOISE CHARACTERIZATION	9

Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems. Narrow band noise – PSD of in-phase and quadrature noise –Noise performance in AM systems – Noise performance in FM systems – Pre-emphasis and de-emphasis – Capture effect, threshold effect.

UNIT V	INFORMATION THEORY	9

Entropy - Discrete Memoryless channels - Channel Capacity -Hartley - Shannon law - Source coding theorem - Huffman & Shannon - Fano codes.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Design AM communication systems.

2.	Design Angle modulated communication systems
3.	Apply the concepts of Random Process to the design of Communication systems
4.	Analyse the noise performance of AM and FM systems
5.	Explain different source coding methods
TEXT BOOKS:	
1.	S. Haykin, "Communication Systems", 4th edition, John Wiley, 2005.
2.	Kennedy G., Bernard Davis "Electronic Communication Systems", McGraw Hill 3rd Edition reprint,2008.
3.	B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition,Oxford University Press 2007.
REFERENCES:	
1.	*Taub and Schilling. ,"Principles of Communication Systems", 2nd edition Mcgraw Hill, 1994.*
2.	*J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2006.*
3.	*Couch.L., "Modern Communication Systems", Pearson, 2001.*
4.	*Roddy and Coolen.," Electronic Communication ", 4th Edition PHI,2007.*
5.	*H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	-	-	-	-	-	-	3	3	3	1	3
CO2	1	3	3	2	3	-	-	-	-	3	3	3	3	1	1
CO3	3	1	1	2	3	-	-	-	-	3	3	3	3	3	1
CO4	3	3	3	2	3	-	-	-	-	3	3	3	2	3	3
CO5	2	2	1	3	1	-	-	-	-	1	-	3	3	1	3
20LPC405	3	2	3	2	3	-	-	-	-	3	3	3	3	3	3

1-LOW 2-MODERATE(MEDIUM) 3-HIGH

20LPC406	DIGITAL ELCTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic postulates of Boolean algebra, methods for simplifying Boolean expressions and shows the correlation between Boolean expressions.
- To analysis and design of combinational circuits and sequential circuits.
- To instantiate basic digital circuits using Verilog HDL

UNIT I	DIGITAL FUNDAMENTALS	9

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

UNIT II	COMBINATIONAL CIRCUITS	9

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder / Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9

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

UNIT IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND DIGITAL INTEGRATED CIRCUITS	9

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

Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan in, Noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

UNIT V	MEMORY DEVICES AND VERILOG INTRODUCTION	9

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA)-Verilog HDL: fundamentals, full adder, D flip flop and ALU design using Verilog HDL

	TOTAL: 45 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Analyse different methods used for simplification of Boolean expressions.
2.	Design and implement of Combinational circuits.
3.	Design and implement of Sequential circuits.
4.	Understand the memory architecture
5.	Understand and instantiate basic digital circuits using Verilog

TEXT BOOKS:	
1.	M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008.
2.	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
3.	Samir Palnitkar." Verilog HDL: A Guide to Digital Design and Synthesis" 2nd Edition, Prentice Hall,2003.

REFERENCES:	
1.	*John F.Wakerly, "Digital Design", Fourth Edition, Pearson / PHI, 2008*
2.	*John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006*
3.	*Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.*
4.	*Jayaram Bhasker, "A Verilog HDL primer", Star Galaxy Press ,2018.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	-	1	-	1	3	3	3	3	3	3
CO2	2	2	3	2	3	-	1	-	1	3	3	3	3	3	3
CO3	2	2	3	2	3	-	1	-	1	3	3	3	3	3	3
CO4	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO5	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
20LPC406	1	2	3	2	2	1	1	-	1	3	3	3	3	3	3

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPC408	ELECTRONIC CIRCUITS - II LABAROTORY	L	T	P	C
		0	0	2	1

Objectives:

- To design and construct practical oscillators and tuned amplifier circuits.
- To design and construct different multivibrator circuits
- To construct various application oriented electronic circuits using operational amplifiers

LIST OF EXPERIMENTS

Design, Simulation & implementation as follows

USING DISCRETE COMPONENTS

1. RC phase shift and colpitt's Oscillators
2. Class C Single Tuned Amplifier
3. Collector Coupled Astable Multivibrator
4. Collector Coupled Monostable Multivibrator
5. Fixed Bias Bistable Multivibrator

USING OP-AMP

1. Inverting and Non-Inverting Amplifiers and Voltage follower
2. Adder, Subtractor, Difference amplifier, Integrator, Differentiator
3. Instrumentation Amplifier
4. Active 2nd Order Butterworth Filters
5. Multivibrators and Schmitt Trigger using Op-Amp
6. Multivibrators using 555 timers.

TOTAL:30 PERIODS

COURSE OUTCOMES:

1.	Construct and troubleshoot oscillator circuits in the laboratory with proper use of test equipment.
2.	Carry out the performance evaluations of different multivibrator circuits.
3.	Understand linear and nonlinear applications of OP-AMPS.
4.	Understand the characteristics of Instrumentation Amplifier.
5.	Design and construct application oriented electronic circuits using OP-AMPS.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	-	2	2	-	2	2	2	2
CO2	2	2	2	2	2	2	2	-	2	2	-	2	2	2	2
CO3	2	2	2	2	2	2	2	-	2	2	-	2	2	2	2
CO4	3	2	2	2	2	2	2	-	2	2	-	2	2	2	2
CO5	3	2	2	2	2	2	2	-	2	2	-	2	2	2	2
20LPC408	3	2	2	2	2	2	2	-	2	2	-	2	2	2	2

20LPC409	DIGITAL ELCTRONICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the Minimization of Boolean Expressions and Logic Gates.
- To familiarize with the design of various combinational digital circuits.
- To familiarize with the design of various sequential digital circuits.

1. Design and implementation of code converters using logic gates
   (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
2. Design and implementation of 4-bit binary Adder / Subtractor and BCD adder using IC7483.
3. Design and implementation of Multiplexer and De-multiplexer using logic gates.
4. Design and Implementation of encoder and decoder using logic gates.
5. Design and Implementation of Parity Generator and Parity checker.
6. Construction and verification of 4-bit ripple counter and Mod-10 / Mod-12 Ripple counters.
7. Design and implementation of 3-bit synchronous up/down counter.
8. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- flops.
9. Implementation of full adder and full subtractor using Verilog HDL.
10. Implementation of flip flop using Verilog HDL.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Design and Testing of code convertors and Adder / Subtractor.
2.	Design and Testing of encoder / decoder and parity generator / checker
3.	Design and Testing of Multiplexer / Demultiplexer.
4.	Design and Testing of counters
5.	Design and Testing of shift registers.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	1	-	1	-	3	3	3	3	3
CO2	3	3	3	2	3	-	1	-	1	-	3	3	3	3	3
CO3	3	3	3	2	3	-	1	-	1	-	3	3	3	3	3
CO4	2	2	2	2	3	-	1	-	1	-	3	3	3	3	3
CO5	2	2	2	2	3	-	1	-	1	-	3	3	3	3	3
20LPC409	3	3	3	2	3	-	1	-	1	-	3	3	3	3	3

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPC410	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To implement Linear and Circular Convolution
- To implement FIR and IIR filter
- To demonstrate finite word length effects

LIST OF EXPERIMENTS: MATLAB / EQUIVALENT SOFTWARE PACKAGE

1.Generation of sequences (functional & random) & correlation

2.Linear and Circular Convolutions

3.Spectrum Analysis using DFT

4.FIR filter design

5.IIR filter design

6.Multirate Filters

7.Equalization

DSP PROCESSOR BASED IMPLEMENTATION

8.Study of architecture of Digital Signal Processor

9.IIR and FIR Implementation

10.Finite Word Length Effect

TOTAL: 30 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	carry out simulation of DSP systems
2.	Analyse Finite word length effect on DSP systems
3.	Demonstrate the applications of FFT to DSP
4.	Demonstrate their abilities towards DSP processor-based implementation of DSP systems
5.	Implement adaptive filters for various applications of DSP

LAB EQUIPMENTFORA BATCH OF 30 STUDENTS (2 STUDENTS PER SYSTEM)

PCs with Fixed / Floating point DSP Processors (Kit / Add-on Cards) 15 Units

LIST OF SOFTWARE REQUIRED: MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems -15 Nos

Signal Generators (1MHz) –15 Nos

CRO (20MHz) -15 Nos

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	1	-	2	-	1	-	-	2	2	3	2
CO2	2	2	-	2	1	-	2	-	1	-	-	2	2	2	2
CO3	2	2	-	2	1	-	1	-	1	-	-	2	2	2	2
CO4	2	2	-	2	2	-	1	-	1	-	-	2	2	2	2
CO5	2	2	-	2	2	-	1	-	1	-	-	2	2	1	2
20LPC410	2	2	-	2	1	-	1	-	1	-	-	2	2	2	2

1-Low 2—Moderate (Medium) 3-High

FIFTH SEMESTER

20LES501	BASIC CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To model electrical and non-electrical system, and determine transfer function for stability analysis
- To analyze the stability of the system in time domain and design compensators.
- To analyze the stability of the system in frequency domain and design compensators.
- To design a compensator to the system.
- To model a system in a state space and analyze response.

UNIT I	INTRODUCTION	9

Transfer Function of Electrical systems - Mathematical modelling of Non-electrical System: mechanical, thermal, and hydraulic systems – Electrical Analogy of mechanical system - Block diagram reduction technique – Signal flow graph analysis

UNIT II	TIME DOMAIN ANALYSIS	9

Time response of First and second-order systems – Time domain Specifications - Steady-state errors and error constants – PID controllers – Stability analysis in time domain - Routh stability criterion – Root Locus Method.

UNIT III	FREQUENCY DOMAIN ANALYSIS	9

Correlation between time & frequency response – Frequency domain specifications – Bode Plot and Polar plots – M and N Circles –Stability in frequency domain – Nyquist plot – Nyquist stability criterion.

UNIT IV	COMPENSATOR DESIGN	9

Introduction to compensators– Lead, Lag and Lead–Lag compensators – Design of lead, lag and lead–lag compensators using root locus – Design of lead, lag and lead–lag compensators using bode plot.

UNIT V	STATE SPACE ANALYSIS	9
Concepts of State space analysis – State models for linear continuous time functions – Diagonalization of transfer function – State equations and solution – controllability & observability – State space representation for Discrete time systems.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon completion the course, the students will have the ability to
1.	Simplify the large component system into single block for Electrical and non-Electrical system.
2.	Design the controllers for compensating steady state errors and improve their stability in time domain.
3.	Design the controllers for improving their stability in frequency domain.
4.	Design different types of compensators.
5.	Design state controller and observer in state space model.

TEXT BOOKS:	
1.	J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2.	M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 2nd Edition, 2002.

REFERENCES:	
1.	*Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.*
2.	*Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.*
3.	*M.Gopal, Digital Control and State Variable Methods, 2nd Edition, TMH, 2007.*
4.	*Schaum's Outline Series, 'Feedback and Control Systems' Tata McGraw-Hill, 2007.*
5.	*Richard C. Dorf & Robert H. Bishop, "Modern Control Systems", Addidon – Wesley, 1999.*

20LPC502	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.

UNIT I	SAMPLING & QUANTIZATION	9

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-quantization - quantization noise - Logarithmic Companding of speech signal- PCM – TDM-Digital Multiplexers.

UNIT II	WAVEFORM CODING	9

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding.

UNIT III	BASEBAND TRANSMISSION	9

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

UNIT IV	DIGITAL MODULATION SCHEME	9

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK, MSK& QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

UNIT V	ERROR CONTROL CODING	9

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes –Turbo codes-Convolutional codes - Viterbi Decoder.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	
1.	Design PCM systems
2.	Design and implement base band transmission schemes
3.	Design and implement band pass signalling schemes
4.	Analyse the spectral characteristics of band pass signalling schemes and their noise performance
5.	Design error control coding schemes
TEXT BOOKS:	
1.	S. Haykin, "Digital Communications", John Wiley, 2005
2.	*J.G Proakis, "Digital Communication", 4th Edition, Tata Mc Graw Hill Company, 2001.*
3.	*B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition Pearson Education, 2009*
REFERENCES:	
1.	*B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition,Oxford University Press 2007.*
2.	*H P Hsu, Schaum Outline Series - "Analog and Digital Communications", TMH 2006*
3.	*Robert G. Gallager, "Principles of Digital Communication", Cambridge.*
4.	*Andrew J. Viterbi, Jim K. Omura, "Principles of Digital Communication".*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	2	-	-	-	-	-	-	3	3	3	1	3
CO2	1	3	3	2	3	-	-	-	-	3	3	3	3	1	1
CO3	3	1	1	2	3	-	-	-	-	3	3	3	3	3	1
CO4	3	3	3	2	3	-	-	-	-	3	3	3	2	3	3
CO5	2	2	1	3	1	-	-	-	-	1	-	3	3	1	3
20LPC502	3	2	2	2	3	-	-	-	-	3	3	3	3	2	2

1-LOW 2-MODERATE(MEDIUM) 3-HIGH

20LPC503	ANTENNA AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Realize a insight of the radiation phenomena
- Understand the various types of antennas radiation and its characteristics
- To learn about the awareness of radio waves propagation at different frequencies

UNIT I	FUNDAMENTALS OF ANTENNA	9

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Matching – Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi array.

UNIT II	APERTURE AND SLOT ANTENNAS	9

Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas – Radiation mechanism – Application, Numerical tool for antenna analysis.

UNIT III	ANTENNA ARRAYS	9

N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array.

UNIT IV	SPECIAL ANTENNAS	9

Principle of frequency independent antennas –Spiral antenna, Helical antenna, Log periodic. Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR.

UNIT V	PROPAGATION OF RADIO WAVES	9

Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading, Multi hop propagation.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Explain the fundamentals of antenna and radiation from a current element.
2.	Analyse the aperture antennas, slot antennas.
3.	Analyse the antenna arrays.
4.	Analyse the special antennas such as frequency independent antennas and antenna measurements.
5.	Explain the various types of wave propagation.
TEXT BOOKS:	
1.	John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2005.
2.	Constantine.A.Balanis, "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
3.	R.E.Collin, "Antennas and Radiowave Propagation", Mc Graw Hill 1985.
REFERENCES:	
1.	*Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006*
2.	*Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.*
3.	*S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.*
4.	*Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.*
5.	*H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	2	-	-	-	-	1	1	3	1	2
CO2	3	3	2	2	1	2	-	-	-	-	1	2	3	2	3
CO3	3	3	2	2	1	2	-	-	-	-	1	2	3	2	3
CO4	3	3	2	2	1	2	-	-	-	-	1	2	3	2	3
CO5	3	3	2	2	1	2	-	-	-	-	2	3	3	3	3
20LPC503	3	3	2	2	1	2	-	-	-	-	1	2	3	2	3

20LHS504	MANAGEMENT THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II	PLANNING	9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANISING	9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV	DIRECTING	9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership –communication – process of communication – barrier in communication – effective communication –communication and IT.

UNIT V	CONTROLLING	9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	
1.	To have clear understanding of managerial skills, roles and have same basic knowledge on international aspect of management
2.	Identify environmental issues as they impact management and develop strategies to adapt to these environments.
3.	Prepare organization structure and design the job.
4.	Identify, discuss and/or describe various theories related to the development of leadership skills, motivation techniques, teamwork and effective communication.
5.	To Work effectively as a team member through group projects, case studies and problem analysis
TEXT BOOKS:	
1.	Stephen P. Robbins & Mary Coulter, "Management", 10th Edition, Prentice Hall (India) Pvt. Ltd., 2009.
2.	JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
REFERENCES:	
1.	*Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7th Edition, Pearson Education, 2011.*
2.	*Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.*
3.	*Harold Koontz & Heinz Weihrich "Essentials of management" Tata Mc Graw Hill, 1998.*
4.	*Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999.*

20ZPC505	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor
- To learn the design aspects of I/O and Memory Interfacing circuits
- To design a microcontroller-based system

UNIT I	THE 8086 MICROPROCESSOR	9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II	8086 SYSTEM BUS STRUCTURE	9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III	I/O INTERFACING	12

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT IV	MICROCONTROLLER	9

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V	INTERFACING MICROCONTROLLER	6

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

	TOTAL: 45 PERIODS

COURSE OUTCOMES	
1.	Understand and execute programs based on 8086 microprocessor
2.	Design Memory Interfacing circuits
3.	Design and interface, I/O circuits.
4.	Understanding the 8051 microcontroller
5.	Design Interfacing circuits for 8051 and programming.
TEXT BOOKS:	
1.	Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 – Microcontroller and Embedded systems", 7th Edition, Pearson Education, 2004
2.	Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007.
3.	Doughlas V.Hall, ―Microprocessors and Interfacing, Programming and Hardware‖,TMH,2012
REFERENCES:	
1.	*A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, TataMcGrawHill, 2012*
2.	*Kenneth.J.Ayala, "8051 Microcontroller Architecture, Programming and Applications", 3rd edition, Thomson, 2007.*
3.	*N. Senthil Kumar, M Saravanan & S Jeevananthan, "Microprocessors and Microcontrollers" Second Edition, Oxford University Press.*
4.	*Barry B. Brey,"8086/8088 Microprocessors: Architecture, Interfacing and Programming",Longman Higher Education*

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	1	-	1	-	1	2	-	1	1	1	2
CO2	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2
CO3	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2
CO4	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2
CO5	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2
20ZPC505	2	2	2	2	1	-	1	-	1	2	-	2	2	1	2

1-LOW **2-MODERATE (MEDIUM)** **3-HIGH**

20LPC508	ANALOG COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To visualize the effects of sampling and TDM
- To Implement AM, FM, PCM & DM modulation and demodulation
- To simulate Digital Modulation and Error control coding schemes

LIST OF EXPERIMENTS:

Using Hardware:

1. Frequency division multiplexing and de-multiplexing
2. Amplitude modulation and demodulation: DSB, SSB
3. Frequency modulation and demodulation
4. Phase modulation and demodulation
5. Pre-emphasis and De-emphasis
6. AM Deduction with AGC
7. Balanced Modulator

Using MATLAB:

8. Amplitude modulation and demodulation
9. Frequency modulation and demodulation
10. Time division multiplexing and de-multiplexing

TOTAL: 30 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Simulate end-to-end Communication Link
2.	Simulate & validate the various functional modules of a communication system
3.	Generate the analog communication system waveforms using hardware
4.	Demonstrate their knowledge in base band signalling schemes through implementation of Digital modulation Scheme.
5.	Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system.

LAB Requirements for a Batch of 30 students (3 students per experiment):

i) Kits for Signal Sampling, TDM, AM, FM, PM, PCM, DM and Line Coding Schemes
ii) CROs/DSOs – 15 No's, Function Generators – 15 No's
iii) MATLAB or equivalent software package for simulation experiments
iv) PCs - 15 No's

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	-	-	-	-	2	2	3	3	3
CO2	2	2	2	2	2	2	-	-	-	-	2	2	2	2	2
CO3	2	2	2	2	2	2	-	-	-	-	1	2	2	2	2
CO4	3	2	2	2	2	2	-	-	-	-	2	2	3	3	3
CO5	3	2	2	2	2	2	-	-	-	-	2	3	3	3	3
20LPC508	3	2	2	2	2	2	-	-	-	-	2	2	3	3	3

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20ZPC509	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVE:

1. To understand the working of micro controller.
2. To understand the programming and debugging
3. To design simple circuits using 8051

LIST OF RECOMMENDED EXPERIMENTS

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Interfacing of Stepper motor
5. Interfacing of Key board and Display

8051 Experiments using kits and MASM

1. Basic arithmetic and Logical operations
2. Counters and Timers
3. PWM generation
4. A/D and D/A interface
5. Interfacing of Switch and Relay

TOTAL:30 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Execute Programs in 8086
2.	Interface different I/Os with processor
3.	Execute Programs in 8051
4.	Interface different I/Os with controller
5.	Generate waveforms using Microcontrollers

20LPR510	PROJECT - I	L	T	P	C
		0	0	3	1.5

OBJECTIVES

•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

(or)

A Minimum of 2 weeks internship in reputed organization during summer vacation

TOTAL : 45 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	**2**	**3**	**4**	**5**	6	7	8	9	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**3**	**2**	**3**	**1**	1	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**1**	1	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**2**	**2**	**2**	**1**	**2**	2	3	3	3	**2**	**3**	**2**	**3**	**3**	**2**
Average	**2.8**	**2.8**	**2.6**	**2.6**	**1.6**	1.6	2.2	3	3	**2.4**	**3**	**2**	**3**	**3**	**2**
20LPR510	**3**	**3**	**3**	**3**	**2**	2	2	3	3	**2**	**3**	**2**	**3**	**3**	**2**
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

SIXTH SEMESTER

20LPC601	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Explain electrical properties of MOS and analyse the CMOS technology.
- Provide concept of combinational and sequential circuits
- Understand the basic of VHDL and Verilog for different logic circuits

UNIT I	MOS TRANSISTOR PRINCIPLE	9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modelling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams

UNIT II	COMBINATIONAL LOGIC CIRCUITS	9

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III	SEQUENTIAL LOGIC CIRCUITS	9

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

UNIT IV	DESIGNING ARITHMETIC BUILDING BLOCKS	9

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

UNIT V	TESTING AND TESTABILITY	9

Introduction to testing: Faults in Logic Circuits – Stuck-at faults, Bridging faults, Delay fault, Breaks and transistors stuck-open and stuck-on or stuck-open faults in CMOS – Basic concepts of fault detection – Testability design: adhoc techniques.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Explain the basic CMOS circuits and the CMOS process technology.
2.	Explain the basic of combinational and sequential circuits
3.	Discuss the techniques of chip design using programmable devices.
4.	Describe the different arithmetic building blocks
5.	Explain different fault identification methods

TEXT BOOKS:	
1.	Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2.	J.Bhasker: Verilog HDL primer, BS publication,2001
3.	M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.

REFERENCES:	
1.	*R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005*
2.	*N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993*
3.	*A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.*
4.	*John Williams, John Michael,"Digital VLSI Design with Verilog", Springer.*
5.	*P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.*
6.	*Michael L. Bushnell and Vishwani D. Agarwal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits", Springer, 2006.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO2	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO3	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO4	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO5	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
20LPC601	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2

20LPC602	RF AND MICROWAVE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To inculcate understanding of the basics required for circuit representation of RF networks.
- To instil knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques

UNIT I	TWO PORT NETWORK THEORY	9

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix

UNIT II	RF AMPLIFIERS AND MATCHING NETWORKS	9

RF behaviour of Resistors, Capacitors and Inductors. Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks

UNIT III	PASSIVE AND ACTIVE MICROWAVE DEVICES	9

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottky diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier

UNIT IV	MICROWAVE GENERATION	9

High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT V	MICROWAVE MEASUREMENTS	9

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

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Discuss about the two port networks and scattering parameters.
2.	Analyse the multi- port RF networks and RF transistor amplifiers.
3.	Explain the active & passive microwave devices & components used in Microwave communication systems.
4.	Generate Microwave signals and design microwave amplifiers.
5.	Measure and analyse Microwave signal and parameters.

TEXT BOOKS:	
1.	Samuel Y Liao, "Microwave Devices & Circuits" , Prentice Hall of India, 2006.
2.	Reinhold.Ludwig and Pavel Bretshko 'RF Circuit Design", Pearson Education, Inc.,2006
3.	Annapurna Das and Sisir K Das, "Microwave Engineering", Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.

REFERENCES:	
1.	*David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 2008.*
2.	*Robert E Colin, "Foundations for Microwave Engineering", John Wiley & Sons Inc, 2005*
3.	*Mathew M Radmanesh, "RF and Microwave Electronics", Prentice Hall, 2000.*
4.	*Thomas H Lee, "Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits", Cambridge University Press, 2004.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	_	_	_	_	_	_	_	3	3	3	1
CO2	3	3	2	2	_	_	_	_	_	_	_	2	2	2	2
CO3	3	2	2	1	_	_	_	_	_	_	_	3	3	3	1
CO4	3	2	3	2	_	_	_	_	_	_	_	2	3	3	1
CO5	3	3	2	2	_	_	_	_	_	_	_	2	2	2	2
20LPC602	3	2	2	2	_	_	_	_	_	_	_	2	3	3	1

1-Low 2-Moderate (Medium) 3-High

20LPC603	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the division of network functionalities into layers
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer

UNIT I	FUNDAMENTALS & LINK LAYER	9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction.

UNIT II	MEDIA ACCESS & INTERNETWORKING	9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP).

UNIT III	ROUTING	9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6.

UNIT IV	TRANSPORT LAYER	9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements.

UNIT V	APPLICATION LAYER	9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- -Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls.

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Discuss about the two port networks and scattering parameters.
2.	Analyse the multi- port RF networks and RF transistor amplifiers.
3.	Explain the active & passive microwave devices & components used in Microwave communication systems.
4.	Generate Microwave signals and design microwave amplifiers.
5.	Measure and analyse Microwave signal and parameters.

TEXT BOOKS:	
1.	Larry L. Peterson, Bruce S. Davie, ―Computer Networks: A Systems Approach‖, Fifth Edition, Morgan Kaufmann Publishers, 2011
2.	Behrouz A. Forouzan, ―Data communication and Networking‖, Fifth Edition, Tata McGraw – Hill, 2013

REFERENCES:	
1.	*James F. Kurose, Keith W. Ross, ―Computer Networking - A Top-Down Approach Featuring the Internet‖, Seventh Edition, Pearson Education, 2016.*
2.	*Nader. F. Mir, ― Computer and Communication Networks‖, Pearson Prentice Hall Publishers, 2nd Edition, 2014*
3.	*Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, ―Computer Networks: An Open Source Approach‖, Mc Graw Hill Publisher, 2011.*

20LPC608	VLSI LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To provide hands on design experience with professional design (EDA) platforms.

LIST OF EXPERIMENTS

FPGA BASED EXPERIMENTS.

1. HDL based design entry and simulation of simple counters, state machines, adders (min 8 bit) and multipliers (4-bit min).
2. Synthesis, P&R and post P&R simulation of the components simulated in (I) above. Critical paths and static timing analysis results to be identified. Identify and verify possible conditions under which the blocks will fail to work correctly.
3. Hardware fusing and testing of each of the blocks simulated in (I). Use of either chip scope feature (Xilinx) or the signal tap feature (Altera) is a must. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs.

IC DESIGN EXPERIMENTS: (BASED ON CADENCE / MENTOR GRAPHICS / EQUIVALENT)

4. Design and simulation of a simple 5 transistor differential amplifier. Measure gain, ICMR, and CMRR
5. Layout generation, parasitic extraction and resimulation of the circuit designed in (I)
6. Synthesis and Standard cell-based design of a circuits simulated in 1(I) above. Identification of critical paths, power consumption.
7. For expt (c) above, P&R, power and clock routing, and post P&R simulation.
8. Analysis of results of static timing analysis.

TOTAL: 30 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Write HDL code for basic as well as advanced digital integrated circuits.
2.	Import the logic modules into FPGA Boards.

3.	Synthesize Place and Route the digital IPs.
4.	Fuse the logical modules on FPGAs
5.	Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	_	_	_	2	_	_	2	3	2	1
CO2	2	2	2	1	3	_	_	_	2	_	_	2	2	3	2
CO3	2	2	1	1	3	_	_	_	2	_	_	2	3	2	2
CO4	3	2	2	1	3	_	_	_	2	_	_	2	2	3	1
CO5	3	2	2	1	3	_	_	_	2	_	_	2	2	3	1
20LPC608	3	2	2	1	3	_	_	_	2	_	_	2	2	3	1

1-Low 2—Moderate (Medium) 3-High

20LPC609	DIGITAL COMMUNICATION AND NETWORKS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To demonstrate different digital communication techniques.
- To analyze different topologies
- To demonstrate and explain different routing techniques.

LIST OF EXPERIMENTS

DIGITAL COMMUNICATION:

1. Pulse Code Modulation and Demodulation
2. Line Coding
3. PAM, PPM, PWM
4. Delta Modulation and Demodulation
5. ASK, FSK and PSK
6. Sampling and Time Division Multiplexing
7. QPSK Modulation and Demodulation

NETWORKING:

1. Network Topology - Star, Bus and Ring
2. Implementation of Link State Routing.
3. Implementation of Distance Vector Routing.
4. Study of Network Simulator (NS) and simulation of congestion control algorithm using NS.

TOTAL: 30 PERIODS

COURSE OUTCOMES	Upon completion of the course, the students will have the ability to
1.	Demonstrate their knowledge in base band signaling schemes through implementation of ASK, FSK, PSK
2.	Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
3.	Implement different topologies.
4.	Implement different routing protocols using simulator
5.	Perform communicate between two desktop computers.

SEVENTH SEMESTER

20ZHS701	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics
- To study the engineering as social experimentation
- To impart knowledge on engineer's responsibility for safety
- To impart knowledge on engineer's responsibility and rights
- To study the global issues on business

UNIT I	ENGINEERING ETHICS	9

Senses of 'Engineering Ethics'–Variety of moral issues–Types of inquiry–Moral dilemmas–Moral Autonomy–Kohlberg's theory–Gilligan's theory–Consensus and Controversy–Professions and Professionalism–Professional Ideals and Virtues–Uses of Ethical Theories.

UNIT II	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as Experimentation–Engineers as responsible Experimenters–Research Ethics – Codes of Ethics–Industrial Standards- A Balanced Outlook on Law–The Challenger Case Study.

UNIT III	ENGINEER'S RESPONSIBILITY FOR SAFETY	9

Safety and Risk–Assessment of Safety and Risk–Risk Benefit Analysis–Reducing Risk–The Government Regulator's Approach to Risk- Chernobyl Case Studies and Bhopal.

UNIT IV	RESPONSIBILITIES AND RIGHTS	9

Collegiality and Loyalty–Respect for Authority–Collective Bargaining–Confidentiality–Conflicts of Interest–Occupational Crime–Professional Rights–Employee Rights– Intellectual Property Rights (IPR) –Discrimination.

UNIT V	GLOBAL ISSUES	9

Multinational Corporations– Business Ethics-Environmental Ethics –Computer Ethics-Role in Technological Development– Weapons Development–Engineers as Managers–Consulting Engineers–Engineers as Expert Witnesses and Advisors–Honesty–Moral Leadership–Sample Code Conduct.

TOTAL: 45 PERIODS

OUTCOMES: Upon the course completion, the student will have the ability to

- Apply the ethical theories in engineering environment.
- Analyse the risks and improve their responsibility for safety.

•	Utilize their rights and improve responsibilities.
•	Utilize their rights and improve rights.
•	Propose remedies for global issues.
TEXT BOOKS:	
1.	Mike Martin and Roland Schinzinger,"Ethics in Engineering", McGraw-Hill, New York(2005).
2.	Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics–Concepts and Cases", Thompson Learning, (2000).
3.	David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)
REFERENCES:	
1.	*Charles D Fleddermann, "Engineering Ethics", Prentice Hall, NewMexico,1999.*
2.	*John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.*
3.	*Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.*
4.	*Prof. (Col) P S Bajaj and Dr.Raj Agrawal, "Business Ethics–An Indian Perspective", Biztantra, NewDelhi,2004.*
5.	*David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press,2003.*

20LPC702	FIBER OPTIC COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand optical fibers and signal transmission properties of optical fibers.
- To familiarize with optical sources and detectors
- To introduce optical networks and networking components.

UNIT I	INTRODUCTION TO OPTICAL FIBERS	9

Evolution of fiber optic system- Element of an Optical Fiber Transmission link-- Total internal reflection-Acceptance angle –Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure

UNIT II	SIGNAL DEGRADATION OPTICAL FIBERS	9

Attenuation - Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave Guides-Information Capacity determination - Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.

UNIT III	FIBER OPTIC SOURCES AND COUPLING	9

Direct and indirect Band gap materials-LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing.

UNIT IV	FIBER OPTIC RECEIVER AND MEASUREMENTS	9

Detectors- Detector response time, Fundamental receiver operation, Pre amplifiers, Error sources – Receiver Configuration-Signal to noise ratio– Probability of Error – Quantum limit, Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements.

UNIT V	OPTICAL NETWORKS AND SYSTEM TRANSMISSION	9
Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Nonlinear effects on Network performance –-Link Power budget -Rise time budget- Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Solutions – Optical CDMA – Ultra High Capacity Networks.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Describe the working of transmission through optical fiber.
2.	Explain different properties of optical fiber links.
3.	Explain the working of different optical sources and detectors.
4.	Define the operation of optical receiver and compare different measurement techniques.
5.	Discuss about networking of systems using optical fiber links.

TEXT BOOKS:	
1.	Gerd Keiser, "Optical Fiber Communication" Mc Graw -Hill International, 4th Edition., 2010.
2.	John M. Senior, “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.
3.	J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

REFERENCES:	
1.	*Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009.*
2.	*J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.*
3.	*Govind P. Agrawal, "Fiber-optic communication systems", John Wiley & Sons, 3rd Edition, 2002.*
4.	*Shiva Kumar, M. Jamal Deen, "Fiber Optic Communications: Fundamentals and Applications", John Wiley & Sons, 2013.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	-	-	-	-	-	2	2	1	2
CO2	3	1	2	1	-	-	-	-	-	-	-	2	2	1	2
CO3	3	1	2	1	-	-	-	-	-	-	-	2	2	1	2
CO4	3	1	2	1	-	-	-	-	-	-	-	2	2	1	2
CO5	3	1	2	1	-	-	-	-	-	-	-	2	3	1	2
20LPC702	3	1	2	1	-	-	-	-	-	-	-	2	2	1	2

1-Low 2—Moderate (Medium) 3-High

20LPC703	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.
- To understand the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.
- To appreciate the contribution of Wireless Communication networks to overall technological growth

UNIT I	WIRELESS CHANNELS	9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT II	CELLULAR ARCHITECTURE	9

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

UNIT III	DIGITAL SIGNALING FOR FADING CHANNELS	9

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix

UNIT IV	MULTIPATH MITIGATION TECHNIQUES	9

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver

UNIT V	MULTIPLE ANTENNA TECHNIQUES	9

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels

	TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Characterize wireless channels and discuss the cellular system design and technical challenges
2.	Analyse Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts
3.	Design and implement various signalling schemes for fading channels
4.	Compare multipath mitigation techniques and Analyze their performance
5.	Design and implement systems with transmit/receive diversity and MIMO systems and Analyze their performance

TEXT BOOKS:	
1.	Rappaport,T.S., "Wireless communications", Second Edition, Pearson Education, 2010.
2.	Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.
3.	David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

REFERENCES:	
1.	*Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.*
2.	*UpenaDalal, "Wireless Communication", Oxford University Press, 2009.*
3.	*Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.*
4.	*Jochen Schiller," Mobile Communications", Second Edition, Pearson Education 2012.*
5.	udhir Dixit and Ramjee Prasad, "Wireless IP and Building the Mobile Internet", Artech House, 2003.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-	2	2	1
CO3	3	2	2	-	2	-	-	-	-	-	-	-	2	2	2
CO4	3	2	3	-	2	-	-	-	-	-	-	-	2	2	2
CO5	3	2	2	3	3	2	1	2	-	2	2	2	3	3	3
20LPC703	3	2	2	1	1	1	-	1	-	1	1	1	2	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPC708	MICROWAVE AND OPTICAL LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To learn about the working of microwave equipment.
- To familiarize with the working of different types of antennas.
- To understand the working optical sources and detectors.

LIST OF EXPERIMENTS

1. Characteristics of Gunn diode Oscillator.
2. Characteristics of Reflex Klystron.
3. Microwave Power Measurement.
4. Characteristics of Directional Coupler and Magic Tee.
5. Guide wavelength and frequency measurement.
6. VSWR and impedance measurements.
7. Dielectric constant measurement.
8. Radiation Patten of Horns, Parabolic and Helical antenna.
9. Measurement of Numerical aperture of optical fiber.
10. Measurement of losses in optical fiber.
11. Digital Transmission through fiber optic link.
12. Characteristics of LED and LASER Diode.
13. Characteristics of Photo Diode
14. Study of Satellite Communication System.
15. Study of Doppler shift using Doppler radar trainer.

TOTAL: 30 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Analyse the characteristics of different microwave equipments.
2.	Compare different microwave devices and choose the required device.
3.	Analyse and compare radiation patterns of different antennas.
4.	Analyse and explain the properties of fiber optical links and devices.
5.	Explain the working of satellite communication systems and Doppler effect.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	1	-	-	3	-	-	2	2	1	2
CO2	3	1	2	1	2	1	-	-	3	-	-	2	2	1	2
CO3	3	1	2	1	2	1	-	-	3	-	-	2	2	1	2
CO4	3	1	2	1	2	1	-	-	3	-	-	2	2	1	2
CO5	3	1	2	1	2	1	-	-	3	-	-	2	3	1	2
20LPC708	3	1	2	1	2	1	-	-	3	-	-	2	2	1	2

1 - Low 2 - Moderate (Medium) 3 - High

20LPR709	PROJECT - II	L	T	P	C
		0	0	6	3

OBJECTIVES

•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

It is intended to start the project work early in the seventh semester and carry out both design and simulation of a device or system whose working can be demonstrated. The design is expected to be completed in the seventh semester and the simulation and its other application, demonstration will be carried out in the eighth semester.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 90 PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	1	1	2	3	3	2	3	2	3	3	2
CO2	3	3	3	3	1	1	2	3	3	2	3	2	3	3	2
CO3	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO5	2	2	2	1	2	2	3	3	3	2	3	2	3	3	2
Average	2.8	2.8	2.6	2.6	1.6	1.6	2.2	3	3	2.4	3	2	3	3	2
20LPR709	3	3	3	3	2	2	2	3	3	2	3	2	3	3	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

EIGHTH SEMESTER

20LPR808	PROJECT - III	L	T	P	C
		0	0	12	6

OBJECTIVES

•	To provide opportunity to explore a problem or issue of particular personal or professional interest.
•	To address the problem or issue through focused study and applied research under the direction of a faculty member.
•	To synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems.
•	To improve ability to think critically and creatively, to solve practical problems,
•	To make reasoned and ethical decisions, and to communicate effectively.

It is intended to start the project work early in the seventh semester and carry out both design and simulation of a device or system whose working can be demonstrated. The design is expected to be completed in the seventh semester and the simulation and its other application, demonstration will be carried out in the eighth semester.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews in that any one review will be conducted with external examiner.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 150PERIODS

OUTCOMES:	On completion of this course, students will be able to
1	Identify the real time Engineering problems in their day to day life.
2	Apply the knowledge and skills acquired in their courses to a specific problem or issue
3	Think critically and creatively to address and help solve these professional or social issues and to further development.
4	Refine research skills and demonstrate their proficiency in written and oral communication skills.
5	Take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.

MAPPING OF COs, POs AND PSOs:															
	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	1	1	2	3	3	2	3	2	3	3	2
CO2	3	3	3	3	1	1	2	3	3	2	3	2	3	3	2
CO3	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO4	3	3	3	3	2	2	2	3	3	3	3	2	3	3	2
CO5	2	2	2	1	2	2	3	3	3	2	3	2	3	3	2
Average	2.8	2.8	2.6	2.6	1.6	1.6	2.2	3	3	2.4	3	2	3	3	2
20LPR808	3	3	3	3	2	2	2	3	3	2	3	2	3	3	2
3- Strong Correlation; 2 - Medium Correlation; 1 – Low Correlation															

PROFESSIONAL ELECTIVES

20LPE001	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about Wireless networks, protocol stack and standards.
- To study about fundamentals of 3G Services, its protocols and applications.
- To study about evolution of 4G Networks, its architecture and applications.

UNIT I	WIRELESS LAN	9

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum - IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security - IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

UNIT II	MOBILE NETWORK LAYER	9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunnelling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing.

UNIT III	MOBILE TRANSPORT LAYER	9

TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks.

UNIT IV	WIRELESS WIDE AREA NETWORK	9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol.

UNIT V	4G NETWORKS	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Acquires knowledge about various WLAN technologies and WiMAX networks and its architecture.
2.	Discuss about various tunnelling, encapsulation and routing methods.
3.	Design and implement wireless network environment for any application using latest wireless protocols and standards.
4.	Implement different types of applications for smart phones and mobile devices with latest network strategies.
5.	Acquires knowledge about the latest 4G networks and cognitive radio.
TEXT BOOKS:	
1.	Jochen Schiller," Mobile Communications", Second Edition, Pearson Education 2012.
2.	Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.
REFERENCES:	
1.	*Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.*
2.	*Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.*
3.	*Simon Haskin, Michael Moher, David Koi lpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	_	_	_	_	_	_	_	3	2	2	1
CO2	2	2	2	1	_	_	_	_	_	_	_	2	2	2	1
CO3	3	2	3	2	_	_	_	_	_	_	_	2	3	3	1
CO4	3	2	3	2	_	_	_	_	_	_	_	2	3	3	1
CO5	3	2	2	2	_	_	_	_	_	_	_	2	2	2	1
20LPE001	3	2	2	2	_	_	_	_	_	_	_	2	2	2	1

1-Low 2—Moderate (Medium) 3-High

20LPE002	Ad-hoc NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the design issues in ad -hoc mobile networks.
- Be familiar with different types of ad-hoc routing protocols.
- Be expose to the TCP issues in ad-hoc networks

UNIT I	FUNDAMENTALS	9

Introduction – Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio Propagation Mechanisms – Characteristics of the Wireless Channel – IEEE 802.11a–b Standard – Origin of Ad hoc Packet Radio Networks – Technical Challenges – Architecture of PRNETs – Components of Packet Radios – Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet.

UNIT II	AD-HOC ROUTING PROTOCOLS	9

Introduction – Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

UNIT III	MULTICAST ROUTING IN AD-HOC NETWORKS	9

Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols – Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols.

UNIT IV	TRANSPORT LAYER SECURITY PROTOCOLS	9
Introduction – Issues in Designing a Transport Layer Protocol for Ad hoc Wireless Networks – Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks – Other Transport Layer Protocols for Ad hoc Wireless Networks – Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.		
UNIT V	**QOS AND ENERGY MANAGEMENT**	**9**
Introduction – Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks–Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Explain the concepts, network architectures and applications of ad hoc networks
2.	Gain knowledge about Ad hoc routing protocols
3.	Analyse the protocol design issues of ad hoc and networks
4.	Design routing protocols for ad hoc networks with respect to some protocol design issues
5.	Evaluate the QoS related performance measurements of ad hoc networks

TEXT BOOKS:	
1.	C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004.
2.	Subir Kumar Sarkar, T.G. Basavaraju, C. Puttamadappa, "Ad Hoc Mobile Wireless Networks Principles, Protocols and Applications" Second Edition CRC Press.

REFERENCES:	
1.	*C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall,PTR, 2001.*
2.	*Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000*
3.	*Mohapatra, Prasant, Krishnamurthy, Srikanth," Ad Hoc Networks Technologies and Protocols" Springer Publications.*
4.	*NabenduChaki, ShilbhadraDasgupta, Soumitra Banerjee "Mobile Adhoc Network and Wireless Communication"Alpha Science International Limited.*
5.	*Carlos De MoraisCordeiro, Dharma PrakashAgrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	1	-	3
CO2	3	3	2	1	-	-	-	-	-	-	-	3	2	-	3
CO3	3	3	2	1	-	-	-	-	-	-	-	3	2	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	3	1	-	3
CO5	3	3	2	1	1	3	1	-	-	-	-	3	2	2	3
20LPE002	3	3	2	1	1	-	-	-	-	-	-	3	2	2	3

20LPE003	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- be able to explain security principles, and be able to analyze and evaluate software systems for its security properties.
- be able to explain how various security mechanisms work, and correlate these security mechanisms with security principles.
- be able to compare various security mechanisms, articulate their advantages and limitations, and able to apply security principles to solve problems.

UNIT I	INTRODUCTION TO NETWORK SECURITY	9

Security Services, Mechanisms and attacks – Network Security Model-Classical Encryption Techniques-Steganography – Data Encryption Standard (DES).

UNIT II	ADVANCED BLOCK CIPHERS	9

Block cipher modes operation-IDEA, Blow Fish, RC5, CAST-128-Characteristics of advanced symmetric Block Ciphers-Key Distribution.

UNIT III	PUBLIC KEY CRYPTOSYSTEMS & MESSAGE AUTHENTICATION	9

Principle-RSA algorithm-Diffie Hellmen Key Exchange-Message Authentication codes-MAC-HASH function-Principle of MD5, SHA-1 and HMAC algorithms-Digital Signature algorithm.

UNIT IV	NETWORK SECURITY	9

Kerbros-X.509 Public key certificate format-PGP-IPSec-SSL-SET.

UNIT V	SYSTEM SECURITY	9

Intrusion Detection-Password Management-Malicious Software-Viruses and countermeasures-Firewall Types and Configurations.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Analyse the different network services.
2.	Describe the advanced block cipher methods.

3.	Describe the public key cryptosystems and message authentication schemes.
4.	Explain the different types of network security schemes.
5.	Explain the requirements of real-time communication security and issues related to the security of web services.

TEXT BOOKS:	
1.	William Stallings, "Cryptography and Network Security", 3rd Edition, Pearson Education, New Delhi, 2003.
2.	Behrouz A. Forouzan , "Cryptography and Network Security", Tata McGraw Hill.

REFERENCES:	
1.	*P. W. Singer, Allan Friedmanm, "Cyber security and Cyber war what everyone needs to know", Oxford University Press.*
2.	*Othmar Kyas, "Internet Security", International Thomson Publishing Inc.1997.*
3.	*Joseph Migga Kissa, "Guide to Computer Network Security", Springer series.*
4.	*Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident ", no starch press.*
5.	*Charlie Kaufman,Radio Perlman and Mike Speciner, " Network Security", 2nd Edition, Prentice Hall of India, New Delhi, 2003.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	2	-	-	-	-	1	-	2	-	-
CO2	2	2	2	-	1	2	-	-	2	-	2	-	2	-	-
CO3	3	1	1	-	3	3	-	-	1	-	2	-	2	-	-
CO4	3	2	-	-	2	2	-	-	2	-	3	-	2	-	-
CO5	2	-	2	-	2	3	-	2	2	-	2	-	2	-	-
20LPE003	2	2	2	-	2	2	-	-	2	-	2	-	2	-	-

20LPE004	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the requirement and fundamentals of Internet of Things.
- To understand the working of each sub-block of Internet of Things
- To learn IoT based access networks and Protocols

UNIT I	IOT FUNDAMENTALS	9

IoT –Definition, Types, Applications, Merits and challenges. IoT components: Sensors, front-end electronics (amplifiers, filtering, digitization), digital signal processing, data transmission, choice of channel (wired/wireless), back-end data analysis - understanding packaging and power constraints for IoT implementation.

UNIT II	SENSORS	9

General Input/Output Configuration- Static Characteristics of Measurement Systems- Dynamic Characteristics.

Sensor Classification: -**Resistive Sensors**- Potentiometers, Strain Gages, Resistive Temperature Detectors (RTDs)- Thermistors, Magnetoresistors, Light-Dependent Resistors (LDRs), Gas Sensors.

Capacitive Sensors- Variable capacitor-level and touch sensors

Inductive Sensors- Variable reluctance sensors, Eddy current sensors, Linear variable differential transformers (LVDTs).

Electromagnetic Sensors- Sensors based on Faraday's law, Hall effect sensors.

Self-Generating Sensors- Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Photovoltaic Sensors.

UNIT III	ACTUATORS AND SENSOR INTERFACING CIRUITS	9

Actuators: Relays, driving/switching circuits: MOSFET, BJT, Bridge (motor drive). DC, Stepper and Servo motor interfacing.

Signal Conditioning: Resistive Sensors- Measurement of Resistance, Voltage Dividers, Wheatstone Bridge: Balance Measurements and Deflection Measurements. Differential and Instrumentation Amplifiers, Interference.

Variable Reactance sensors- ac Bridges, Carrier Amplifiers and Coherent Detection. **Self-Generating Sensors** - Chopper and Low-Drift Amplifiers, Electrometer and Transimpedance Amplifiers, Charge Amplifiers. Noise in Amplifiers- Noise and Drift in Resistors.

UNIT IV	IOT NETWORKS	9

Review -OSI Model, Layering and protocols, IPV4 and IPV6.

Non-IP Based WPAN: IEEE 802.15 Standards, Bluetooth (version 4 and 5), IEEE 802.15.4, Zigbee,Z-wave, Wireless HART,DASH 7.

IP Based WPAN and LAN: 6LoWPAN, IEEE 802.11, Ethernet (IEEE 802.3).

WAN: 4G-LTE, LoRa and LoRaWAN, Sigfox, NB-IOT, INGENU-RPMA

UNIT V	PROTOCOLS	9
Routing Protocols: Introduction to Routing, Protocols: RPL, CORPL, CARP. **Session Protocols**: REST-HTTP, MQTT, CoRE, CoAP, AMQP, DDS, XMPP. **Security Protocols:** TLS/DTLS		
		TOTAL: 45 PERIODS

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Summarize the requirements and fundaments of Internet of Things
2.	Differentiate different sensors/actuators based on the working principle
3.	Analyse various interfacing circuits for sensors and actuators.
4.	Explain different access network technologies for Internet of Things
5.	Discuss various protocols for Internet of Things

TEXT BOOKS:	
1.	Raman Pallas-Areny, John.G.Webster, “Sensors and Signal Conditioning”, Second Edition, John Wiley and Sons, 2001
2.	Perry Lea, "Internet of Things for Architects", Packt Publishing Ltd,2018.
3.	Bharat.S.Chaudhari, Marco Zennaro, "LPWAN Technologies for IoT and M2M Applications", Elsevier Academic Press, 2020.

REFERENCES:	
1.	*Robert.H.Bishop,"The Mechatronics Handbook", CRC Press,2002*
2.	*Jacob Fraden,"Handbook of Modern Sensors- Physics, Designs and Applications", Third Edition, AIP Press Springer, 2004.*
3.	*Greg Dunko, Joydeep Misra, Josh Robertson, Tom Snyder,"A Reference Guide to the Internet of Things", Bridgera LLC, RIoT, 2017*
4.	*Steve Rackley,"Wireless Networking Technology- From Principles to Successful Implementation",Elsevier Newness, 2007.*
5.	*Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks- Theory and Practice", John Wiley and Sons,2010.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	-	2	-	-	-	1	-	1	1	1	1
CO2	1	-	-	-	-	-	-	-	-	1	-	1	2	2	1
CO3	2	1	2	1	2	-	-	-	-	-	-	2	2	2	1
CO4	1	1	1	1	2	-	-	-	-	-	-	2	2	2	2
CO5	2	2	1	1	2	-	-	-	-	1	-	2	1	1	2
20LPE004	1	1	1	2	2	-	-	-	-	1	-	2	2	2	1

1-LOW 2-MODERATE(MEDIUM) 3-HIGH

20LPE005	STATISTICAL THEORY OF COMMUNICATION	L	T	P	C
		2	1	0	3

OBJECTIVES:

- The course presents a unified approach to the problem of detection, estimation and modulation theory, which are common tools used in many applications of communication systems, signal processing and system theory.
- The goal is to develop decision, estimation and modulation theories to demonstrate how they can be used to solve a wealth of practical problems in many diverse physical situations.
- The idea is to develop a qualitative understanding of these three areas by examining problems of interest.

UNIT I	CLASSICAL DETECTION AND ESTIMATION THEORY	6+3

Introduction – Simple binary hypothesis tests – M Hypothesis – Estimation theory – Composite hypothesis – General Gaussian problem – Performance bounds and approximations.

UNIT II	REPRESENTATIONS OF RANDOM PROCESSES	6+3

Deterministic functions: Orthogonal representations – Random process characterization – Homogeneous Integral equations and Eigen functions – Periodic processes – Infinite time interval: Spectral decomposition – Vector Random processes.

UNIT III	DETECTION OF SIGNALS – ESTIMATION OF SIGNAL PARAMETERS	6+3

Detection and Estimation in White Gaussian and Non-White Gaussian noise – Signals with unwanted parameters: The Composite hypothesis problem – Multiple channels – Multiple parameter estimation.

UNIT IV	ESTIMATION OF CONTINUOUS WAVEFORMS	6+3

Derivation of Estimator equations – A Lower bound on the mean square estimation error – Multidimensional waveform estimation – Non-random waveform estimation.

UNIT V	LINEAR ESTIMATION	6+3

Properties of Optimum processors – Realizable Linear filters: Stationary processes, Infinite past: Wiener filters – Kalman-Bucy filters – Linear Modulation: Communications context – Fundamental role of the Optimum linear filter.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Develop decision and estimation theories.
2.	Analyze different representations of random processes.
3.	Describe the detection and estimation of signals.
4.	Analyze the estimation of continuous waveforms.
5.	Design linear estimation methods.

TEXT BOOKS:	
1.	P. Eugene Xavier, "Statistical theory of Communication", New Age International Ltd. Publishers, New Delhi, 2007
2.	Yuk-Wing Lee "Statistical theory of communication", Literary Licensing LLC,2013.

REFERENCES:	
1.	*Prof. B.R. Levin, "Statistical communication theory and its applications", MIR Publishers, Moscow, 1982*
2.	*Carl W.Helstrom, "Statistical theory of signal detection", Second edition, Elsevier.*
3.	*Robert M.Fano, "Transmission of information a statistical theory of communication", IT ,Press.*
4.	*Harry L. Van Trees, "Detection, Estimation and Modulation theory"– Part I/ Edition 2, JohnWiley & Sons, NY, USA, 2013.*
5.	*S P Eugene Xavier ,"Statistical theory of Communication" Paperback – 2007.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	1	-	-	-	2	-	3	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	1	-	-	2	-	-	-	-	1	1	3	2	-
CO4	2	2	1	-	1	2	1	-	-	-	-	1	2	-
CO5	1	2	2	-	1	1	2	-	-	2	-	2	2	-
20LPE005	3	2	1	-	2	2	1	-	-	-	1	1	1	-

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE006	SPREAD SPECTRUM TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the spread spectrum and its basic applications in communication.
- Over the years, the most successful implementation of spread spectrum communication in commercial world lies in CDMA 2000, WCDMA and UMTS, WLAN, Ultra-Wideband Communications (UWB)
- To expose the students about the fundamental of optical communication

UNIT I	2.5G EVOLUTION& 3G OVERVIEW	9

EDGE, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, TD-CDMA, TD-SCDMA, IS-95, IMT-2000: Third generation Mobile Communication Systems, W-CDMA, CDMA-2000.

UNIT II	SPREAD SPECTRUM CONCEPTS	9

Spread Spectrum Modulation- Pseudo- noise sequences–a notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying – Signal space Dimensionality and processing gain – Probability of error – Frequency –hop spread spectrum –Maximum length and Gold codes.

UNIT III	OPTICAL CDMA	9

Introduction; Optical CDMA codes - Construction of Coherent and Incoherent Codes, Performance Analysis and Comparison of Coherent and Incoherent Codes, Advanced Incoherent Codes, Information Capacity of Fiber-Optical CDMA Systems, Advanced Coding Techniques for Performance Improvement.

UNIT IV	COHERENT AND INCOHERENT OPTICAL CDMA SYSTEMS	9

Introduction, Coherent OCDMA Approaches, Subsystem Technologies, Code Selection for SPC-OCDMA, OCDMA Network Architectures for SPC-OCDMA - WHTS System Architecture, Technologies for WHTS OCDMA.

UNIT V	OPTICAL CDMA ARCHITECTURES	9
Hybrid Multiplexing Transmission System, Photonic Gateway: Multiplexing Format Conversion, OCDMA/WDM Virtual Optical Path Cross Connect, Optical CDMA network architectures and applications-Local Area Networks.		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Interpret the Spread Spectrum Concepts
2.	Describe the 3G technology
3.	Acquaint with the concepts of Optical CDMA and its architecture.
4.	Describe the basic concept of wireless communication system.
5.	OCDMA is a promising technology for next generation ultra-high speed, cost effective broadband access network.

TEXT BOOKS:	
1.	S. Haykin, "Digital Communications", John Wiley, 2005
2.	Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, Tata McGraw Hill, 2007.
3.	Paul R. Prucnal, "Optical Code Division Multiple Access- Fundamentals and Applications", Taylor & Francis Ltd; Har/Cdr edition, 2005.

REFERENCES:	
1.	*Guu-Chang Yang & Wing C. Kwong, "Prime Codes with Applications to CDMA Optical and Wireless Networks", Artech House, 2002.*
2.	*Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007*
3.	*Don Torrieri," Principles of Spread-Spectrum Communication Systems", Springer, 2004*
4.	*RajPandya, "Mobile and Personal Communication systems and services", PHI, New Delhi, 2003.*
5.	*ShlomiArnon, John R. Barry, George K. Karagiannidis, Robert Schober, Murat Uysal"Advanced Optical Wireless Communication Systems" Cambridge University Press 2012*

COURSE ARTICULATION MATRIX:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	1	2	2	3	-	-	3	-	-
CO2	3	2	2	3	3	-	-	-	-	-	2	2	1	1	
CO3	2		3	3	1	1	-	-	1	2	2	1	2	3	3
CO4	3	3	2	-	-	-	2	2	3	1	1		3	-	-
CO5		2	2	3	1	3	2		3	3	1	1	-	-	3
20LPE006	2	1	2	2	1	-	1	-	1	1	1	1	1	-	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE007	COMMUNICATION ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the operation of different blocks in communication system
- Familiarize with different oscillators, modulators, filters, amplifiers, synthesizers.
- To study about link characteristics and microwave components.

UNIT I	OSCILLATORS AND MODULATION SYSTEMS	9

Oscillators: Principle, types-RC, LC, crystal oscillator, frequency stability. Modulation: Analog and digital modulation techniques.

UNIT II	FILTERS AND TUNED AMPLIFIER	9

Passive and active filter, First order and second order low pass and high pass filter, Band pass filter, Switched capacitor filter, Notch filter, Selecting components for filter, Testing filter response. Tuned circuits

UNIT III	POWER AMPLIFIER	9

Transistor characteristics, small signal voltage amplifier, power amplifier types, power and efficiency calculation, integrated circuit power amplifier, radio frequency power amplifier, measurement.

UNIT IV	PHASE LOCKED LOOPS AND SYNTHESIZERS	9

Phase locked loop elements, compensation, Integrated phase locked loops, PLL design using HCC4046B, frequency synthesis.

UNIT V	MICROWAVE DEVICES AND COMPONENTS	9

Phase delay, propagation velocity, propagation constant, secondary constant, transmission line distortion, wave reflection, reflection coefficient, SWR, wave guide characteristics, microwave passive components-directional coupler, waveguide junction, cavity resonator, probes, circulators and isolators, microwave active devices- solid state devices, microwave tubes, multicavity magnetrons.

	TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Explain the operation of different oscillators and modulation techniques.
2.	Compare different filters and amplifiers.
3.	Discuss about the design of power amplifiers.
4.	Explain the operation of phase locked loops and frequency synthesizers.
5.	Describe about the properties of links and microwave components.
TEXT BOOKS:	
1.	Andrew Leven," Telecommunication Circuits and Technology", Butterworth Heinemann
2.	Donald O. Peterson, Kartikeya Mayaram, "Analog Integrated Circuits for Communication Principles, Simulation and Design" Second Edition, Springer, 2010.
REFERENCES:	
1.	*Cornell Drentta, "Modern Communications Receiver Design and Technology", Artech House,2010*
2.	*Sedra and Smith, "Micro Electronic Circuits", Sixth Edition, Oxford University Press, 2011.*
3.	*B.S. Sonde, "System Design using Integrated Circuits", 2nd Edition, New Age Pub,2001.*
4.	*Scott R. Bullock, "Transceiver and system design for digital communication" 3rd Edition, Scitech Publishing.*
5.	*Mathew M Radmanesh, "RF and Microwave Electronics", Prentice Hall, 2000.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO2	3	2	3	1	-	-	-	-	-	-	-	2	2	2	2
CO3	3	2	3	-	2	-	-	-	-	-	-	2	3	3	2
CO4	3	2	3	1	-	-	-	-	-	-	-	2	2	2	2
CO5	3	2	3	-	2	-	-	-	-	-	-	2	3	3	2
20LPE007	3	2	3	1	1	-	-	-	-	-	-	2	2	2	2

1-Low 2—Moderate (Medium) 3-High

20LPE008	TELECOMMUNICATION SWITCHING NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

•	Student can understand the concept of switching, signalling and traffic in the telecommunications network's environment.
•	To acknowledge the facilities, multiplexing, and modulation techniques used in long-distance backbone networks,
•	To understand the ISDN architecture, high data rate digital subscriber loops

UNIT I	MULTIPLEXING	9

Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing: Pulse Transmission, Line Coding, Binary N-Zero Substitution, Digital Biphase, Differential Encoding, Time Division Multiplexing, Time Division Multiplex Loops and Rings, SONET/SDH: SONET Multiplexing Overview, SONET Frame Formats, SONET Operations, Administration and Maintenance, Payload Framing and Frequency Justification, Virtual Tributaries, DS3 Payload Mapping, E4 Payload Mapping, SONET Optical Standards, SONET Networks. SONET Rings: Unidirectional Path-Switched Ring, Bidirectional Line-Switched Ring.

UNIT II	DIGITAL SWITCHING	9

Switching Functions, Space Division Switching, Time Division Switching, two-dimensional Switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment. Elements of SS7 signalling.

UNIT III	NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT	9

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

UNIT IV	DIGITAL SUBSCRIBER ACCESS	9

ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber

Coax Systems, Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.		
UNIT V	**TRAFFIC ANALYSIS**	**9**
Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.		
	TOTAL:45PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Analyze the different multiplexing methods.
2.	Summarize the concepts associated with telecommunication digital switching
3.	Describe the network synchronization control and management schemes.
4.	Explain the different types of digital subscriber access.
5.	Analyze the traffic management in telecommunication networks.

TEXT BOOKS:	
1.	J. Bellamy, "Digital Telephony", John Wiley, 2003, 3rd Edition.
2.	Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., 1994.
3.	J.E Flood, "Telecommunications Switching, Traffic and Networks", Pearson.

REFERENCES:	
1.	*R.A.Thomson, "Telephone switching Systems", Artech House Publishers, 2000*
2.	*W. Stalling, "Data and Computer Communications", Prentice Hall, 1993.*
3.	*T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience, 1994.*
4.	*W.D. Reeve, "Subscriber Loop Signaling and Transmission Hand book", IEEE Press(Telecomm Handbook Series), 1995.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	1	2	2	-	3	3	2	2	3	3	3
CO2	2	2	2	2	1	2	1	-	2	3	2	3	3	2	2
CO3	3	3	1	2	3	3	1	-	3	3	2	3	3	2	3
CO4	3	2	2	3	2	2	2	-	2	3	3	3	3	2	2
CO5	2	2	3	2	2	3	1	-	3	3	2	2	3	3	3
20LPE008	2	2	2	2	1	2	1	-	2	3	2	2	3	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE009	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Know the basics of the software defined radios.
- Learn the design of the wireless networks based on the cognitive radios
- Understand the concepts of wireless networks and next generation networks

UNIT I	INTRODUCTION TO SOFTWARE DEFINED RADIO	9

Definitions and potential benefits, software radio architecture evolution, technology trade-offs and architecture implications.

UNIT II	SDR ARCHITECTURE	9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules

UNIT III	INTRODUCTION TO COGNITIVE RADIOS	9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV	COGNITIVERADIOARCHITECTURE	9

Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT V	NEXT GENERATION WIRELESS NETWORK	9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Describe the basics of the software defined radios.
2.	Analyze the architecture of SDR
3.	Design the wireless networks based on the cognitive radios
4.	Analyze the architecture of Cognitive radio
5.	Explain the concepts behind the wireless networks and next generation networks

TEXT BOOKS:	
1.	Joseph MitolaIII," Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.
2.	Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3.	Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4.	Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.

REFERENCES:	
1.	*Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.*
2.	*Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.*
3.	*Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.*
4.	*Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.*
5.	*Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**3**	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**-**	**-**	**3**	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**2**	**-**
CO3	**2**	**-**	**1**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**2**
CO4	**-**	**3**	**2**	**1**	**-**	**3**		**1**	**1**	**1**	**-**	**-**	**1**	**-**	**3**
CO5	**3**	**3**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**
20LPE009	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE010	AUTOMOTIVE ELECTRONIC SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I	FUNDAMENTAL OF AUTOMOTIVE ELECTRONICS	9

Current trends in modern Automobiles- Open loop and closed loop systems - Components for electronic engine management- Electronic management of chassis system - Vehicle motion control.

UNIT II	SENSORS AND ACTUATORS	9

Introduction, basic sensor arrangement types of sensors such as - oxygen sensors Crank angle position sensors - Fuel metering / vehicle speed sensor and detonation sensor - Altitude sensor, flow sensor Throttle position sensors, solenoids, stepper motors, relays.

UNIT III	ELECTRONIC FUEL INJECTION AND IGNITION SYSTEMS	9

Introduction Feedback carburettor systems (FBC) Throttle body injection and multi-port or point fuel injection, Fuel injection systems, injection system controls

UNIT IV	ELECTRONIC IGNITION SYSTEMS	9

Introduction Advantages of electronic ignition systems. Types of solid-state ignition systems and their principle of operation Contactless electronic ignition system, Electronic spark timing control.

UNIT V	DIGITAL ENGINE CONTROL SYSTEM	9

Open loop and closed loop control systems Engine cranking and warm up control Acceleration enrichment - Deceleration leaning and idle speed control Distributor less ignition - Integrated engine control system Exhaust emission control engineering.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Apply the fundamentals of automotive electronics.
2.	Design sensors and actuators.
3.	Analyze electronic fuel injection and ignition system.
4.	Describe electronic ignition system.
5.	Design and Implement a digital engine control system.

TEXT BOOKS:	
1.	William B.Riddens, " Understanding Automotive Electronics ", 5th Edition, Butterworth, Heinemann Woburn, 1998.
2.	Tom Weather Jr and Cland C.Hunter, " Automotive Computers and Control System ". Prentice Hall Inc., New Jersey.
3.	T.Mellard, " Automotive Electronics ".
REFERENCES:	
1.	*Crouse. W.H., " Automobile Electrical equipment ", McGraw Hill Book Co Inc., New York, 1955.*
2.	*Robert N Brady, " Automotive Computers and Digital Instrumentation ". A reston Book. Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.*
3.	*Bechtold., " Understanding Automotive Electronic ", SAE, 1998.*
4.	*Young. A.P. and Griffths.L. " Automobile Electrical Equipment ", English Language Book Society and New Press.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3			2	3	-	-	2	-	-	-	-	-	-	3	
CO4	2	2	2	3	3	2	-	-	-	-	-	-	-	3	3
CO5	1	3	3	2	3	2	2	2	2	2	2	-	-	2	3
20LPE010	1	1	1	1	1	-	-	-	-	-	-	-	-	1	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE011	ADVANCED DISPLAY DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the basics of the display systems and to illustrate the current design practices of the display systems
- To gain exposure in the basics of the display systems.
- To illustrate the current design practices of the display systems.

UNIT I	INTRODUCTION	9

Introduction to displays-Requirements of displays-Display technologies, CRT, Flat panel and advanced display technologies-Technical issues in displays.

UNIT II	HEAD MOUNTED DISPLAY	9

Head mounted displays. Displays less than and greater than 0.5 m diagonal. Low power and light emitting displays.

UNIT III	TFT, MIMS, LCD	9

Operation of TFTs and MIMS. LCDs, Brightness. Types of LCD displays.

UNIT IV	EMISSIVE DISPLAYS	9

Emissive displays, ACTFEL, Plasma display and Field emission displays, operating principle and performance.

UNIT V	TYPES OF DISPLAYS	9

Types of Displays: 3D, HDTV, LED, Touchscreen.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Gains knowledge of technical requirements of different types of display systems.
2.	Analyse the various low power system.
3.	Understand the operation of TFTs and LCD display.

4.	Analyse the various kinds of emissive displays.
5.	Describe the types of displays.

TEXT BOOKS:	
1.	L.W. Mackonald & A.C. Lowe, Display Systems, Design and Applications, Wiley,2003.
2.	E.H. Stupp &M. S. Brennesholtz, Projection Displays, Wiley,1999.
3.	Peter A. Keller, Electronic Display Measurement: Concepts, Techniques, and Instrumentation, Wiley-Interscience, 1997.
REFERENCES:	
1.	*YoshimosoA.Ono, "Electroluminescent Displays" World Scientific Publishers.*
2.	*Shoichimatsumoto, "Electronic display devices "Wiley publications.*
3.	*Deng Keyang ,ShinTson Wu, "Fundamentals of liquid crystal devices" ,John Wiley &Sons ,2006.*
4.	*J. Pankove, "Display Devices", Springer.*
5.	*Janglin Chen, Wayne Cranton, Mark Fihn , "Handbook of Visual Display Technology", Springer Publication.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**3**	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**3**	**1**	**1**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
CO3	**1**	**1**	**-**	**2**	**2**	**-**		**2**	**2**	**1**	**1**	**1**	**1**	**-**	**2**
CO4	**3**	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**3**
CO5	**3**	**2**	**2**	**-**	**-**	**2**	**3**	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**3**
20LPE011	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE012	DIGITAL SPEECH PROCESSING	L	T	P	C
		2	1	0	3

OBJECTIVES

- To introduce speech production and related parameters of speech.
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech.
- To understand different types of speech coding and synthesis methods

UNIT I	INTRODUCTION	6+3

The Speech Chain, Applications of Digital Speech Processing, Phonetic Representation of Speech, Models for Speech Production, Hearing and Auditory Perception

UNIT II	SPEECH ANALYSIS	6+3

Short-Time Analysis of Speech, Homomorphic Speech Analysis, Linear Predictive Analysis

UNIT III	DIGITAL SPEECH CODING	6+3

Sampling and Quantization of Speech, Digital Speech Coding, Closed-Loop Coders, Open-Loop Coders, Frequency-Domain Coders, Evaluation of Coders

UNIT IV	TEXT TO SPEECH SYNTHESIS METHODS	6+3

Text Analysis, Evolution of Speech Synthesis Systems, Unit Selection Methods, TTS Applications, TTS Future Needs

UNIT V	AUTOMATIC SPEECH RECOGNITION	6+3

Building a Speech Recognition System, The Decision Processes in ASR, Representative Recognition Performance, Challenges in ASR Technology

	TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	To understand the role of DSP in speech communication
2.	To understand the methods of representing the speech in digital form
3.	To understand the different types of coding techniques used for digital speech processing

4.	Acquire knowledge about different types of speech synthesis methods
5.	Acquire knowledge about automatic synthesis and recognition of speech
TEXT BOOKS:	
1.	Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2.	Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education, 2004.
REFERENCES:	
1.	*Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2002.*
2.	*Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997*
3.	*Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.*
4.	*Claudio Becchetti and LucioPrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.*
5.	*Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	1	1	3	1	2	2	1	2	2
CO2	2	2	2	2	2	3	1	1	3	1	2	2	2	2	2
CO3	2	2	2	3	3	3	1	1	3	1	2	3	3	2	2
CO4	2	2	2	3	3	3	1	1	3	1	2	3	3	2	2
CO5	2	2	2	3	3	3	1	1	3	1	2	3	3	2	2
20LPE012	2	2	2	3	3	3	1	1	3	1	2	3	3	2	2

20LPE013	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	1	0	3

OBJECTIVES:

- Exposure to concepts of random processes and spectrum estimation
- To familiarize the concepts of linear estimation and prediction
- To introduce adaptive filters and wavelet transforms

UNIT I	DISCRETE-TIME RANDOM SIGNALS	6+3

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II	SPECTRUM ESTIMATION	6+3

Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion.

UNIT III	LINEAR ESTIMATION AND PREDICTION	6+3

Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.

UNIT IV	ADAPTIVE FILTERS	6+3

Principles of adaptive filter – FIR adaptive filter – Newton's Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.

UNIT V	WAVELET TRANSFORM	6+3

Multiresolution analysis, Continuous and discrete wavelet transform, Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.

	TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Understand the concepts of random processes
2.	Compare different methods of spectrum estimation.
3.	Gain knowledge on linear estimation and prediction
4.	Understand different adaptive filtering techniques and the applications of adaptive filtering.
5.	Learn about wavelet transform

TEXT BOOKS:	
1.	Monson H, Hayes, "Statistical Digital Signal Processing and Modelling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2.	John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth 2007

REFERENCES:	
1.	*Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", Mc Graw Hill, 1990.*
2.	*Oppenheim, A. V., R. W. Schafer, and J. R. Buck. "Discrete-Time Signal Processing", 2nd ed. Prentice Hall*
3.	*Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.*
4.	*McClellan, J. H., et al. Computer-Based Exercises for Signal Processing Using MATLAB® 5. Prentice Hall, 1998*
5.	*Crochiere, Ronald E., and Lawrence R. Rabiner. Multirate Digital Signal Processing. Prentice Hall, 1983*

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	2	1	-	-	-	-	-	-	2	2	-	1
CO2	3	2	1	1	1	-	-	-	-	-	-	2	2	1	2
CO3	2	1	2	1	2	-	-	-	-	-	-	2	2	1	1
CO4	2	2	2	1	2	-	-	-	-	-	-	2	2	2	2
CO5	2	2	1	2	-	-	-	-	-	-	-	2	1	-	2
20LPE013	2	2	1	1	1	-	-	-	--	-	-	2	-	1	2

1-Low 2—Moderate (Medium) 3-High

20LPE014	DSP ARCHITECTURES AND PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basics of Programmable DSP‘s Architecture, On-chip Peripherals and Instruction set.
- To gain the knowledge of programming for signal processing applications.
- Learn the concepts of adaptive filter.

UNIT I	INTRODUCTION TO DSP PROCESSOR	9

Introduction to a popular DSP from Texas Instruments TMS320C6XXX– CPU Architecture (VLIW) - CPU Data Paths and Control - Timers - Internal Data/ Program Memory - External Memory Interface, Difference between fixed- and floating-point processors.

UNIT II	DSP DEVICES	9

DSP devices beyond the core, TI C6xxx EVM memory configuration, wait state generator, DMA, Hardware interfacing and I/O control, System management and control.

UNIT III	PROGRAMMING	9

Programming - Linear and Circular Addressing Modes, Assembly code format, Types of Instructions, Assembler directives Code Composer Studio - Code Generation Tools (Compiler, Assembler, Linker) - Code Composer Studio Debug Tools – Simulator.

UNIT IV	ADAPTIVE FILTERING	9

Adaptive filtering Introduction to adaptive filters, adaptive filter structures and algorithms, Properties of adaptive filters, Applications, Adaptive filtering in C using floating-point processors

UNIT V	SHARC DIGITAL SIGNAL PROCESSOR	9

Sharc Digital Signal Processor: A popular DSP from Analog Devices - Sharc/ Tiger Sharc/ Blackfin (one of them) - Architecture - IOP Registers - Peripherals - Synchronous Serial Port - Interrupts - Internal/External/Multiprocessor Memory Space - Multiprocessing - Host Interface - Link Ports.

	TOTAL :45 PERIODS

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Describe about DSP Processor.
2.	Analyse the different DSP devices.
3.	Write DSP programs for different applications.
4.	Explain the adaptive filtering and its applications.
5.	Utilize Sharc DSP processor.
TEXT BOOKS:	
1.	Naim Dahnoun, "Digital Signal Processing Implementation" Using the TMS320C6000DSP Platform, 1st Edition, 2000.
2.	Sen M Kuo, Woon- Seng S Gan, "Digital Signal Processors Architectures,Implementations and Applications", Pearson Education.
3.	David J Defatta J, Lucas Joseph G & Hodkiss William S, Digital Signal Processing:A System Design Approach, 1st Edition, John Wiley
REFERENCES:	
1.	*B.Venkataramani, M.Bhaskar, " Digital Signal Processors Architectures, Implementations and Applications", 2nd Edition, Tata McGraw-Hill.*
2.	*Rulph Chassaing, "DSP Applications using 'C' and the TMS320C6X DSK", 1st Edition, 2002.*
3.	*Phil Lapsley, Jeff Bier, Amit Shoham, Edward A.Lee"DSP Processor Fundamentals: Architectures and Features", A Volume in the IEEE Press Series on Signal Processing.*
4.	*T.J. Terrel and Lik-Kwan Shark, "Digital Signal Processing" - A Student Guide,1st Edition; Macmillan Press Ltd.*
5.	*Andrew Bateman, Iain Paterson-Stephens, "The DSP Handbook – Algorithms, Applications and Design Techniques", Pearson Education.*

COURSE ARTICULATION MATRIX:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	1	-	-	-	-	1	1	3	2	2
CO2	3	2	2	2	2	1	-	-	-	-	2	2	3	2	3
CO3	3	2	2	3	3	1	-	-	-	-	3	3	3	2	3
CO4	3	2	2	1	1	1	-	-	-	-	2	2	3	2	2
CO5	3	2	2	2	2	1	-	-	-	-	1	1	3	2	2
20LPE014	3	2	2	2	2	1	-	-	-	-	2	2	3	2	2

20LPE015	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Objectives:

- Understand fundamental of digital image
- Learn different image transforms
- Study concept of segmentation

UNIT I	DIGITAL IMAGE FUNDAMENTALS	9

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models.

UNIT II	IMAGE ENHANCEMENT	9

Spatial **Domain:** Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – **Frequency Domain:** Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters

UNIT III	IMAGE RESTORATION AND SEGMENTATION	9

Noise **models** – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering **Segmentation:** Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation.

UNIT IV	WAVELETS AND IMAGE COMPRESSION	9

Wavelets – Subband coding - Multiresolution expansions - **Compression:** Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

UNIT V	IMAGE REPRESENTATION AND RECOGNITION	9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

	TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Discuss digital image fundamentals.
2.	Apply image enhancement and restoration techniques.
3.	Use image compression and segmentation Techniques.
4.	Represent features of images
5.	Recognize image from features.

TEXT BOOKS:	
1.	Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2.	Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3.	*Willliam K Pratt, "Digital Image Processing", John Willey, 2002.*

REFERENCES:	
1.	*Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.*
2.	*Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.*
3.	*http://eeweb.poly.edu/~onur/lectures/lectures.html.*
4.	*http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	_	_	_	_	2	_	2	1	_
CO2	2	2	3	2	2	1	_	_	_	_	1	_	2	2	_
CO3	3	2	3	2	1	1	_	_	_	_	2	_	2	2	1
CO4	3	3	2	2	_	_	_	_	_	_	2	_	3	2	_
CO5	3	2	2	2	2	2	1	_	_	_	2	_	2	2	2
20LPE015	3	3	2	2	1	2	_	_	_	_	2	_	2	2	2

1-Low 2—Moderate (Medium) 3-High

20LPE016	MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators.

UNIT I	INTRODUCTION TO MEMS AND MICROFABRICATION	9

History of MEMS Development, Characteristics of MEMS-Miniaturization - Microelectronics integration - Mass fabrication with precision. Micro fabrication - microelectronics fabrication process- Silicon based MEMS processes- New material and fabrication processing- Points of consideration for processing.

UNIT II	ELECTRICAL AND MECHANICAL PROPERTIES OF MEMS MATERIALS	9

Conductivity of semiconductors, crystal plane and orientation, stress and strain – definition – Relationship between tensile stress and strain- mechanical properties of Silicon and thin films, Flexural beam bending analysis under single loading condition- Types of beam- deflection of beam-longitudinal strain under pure bending- Spring constant, torsional deflection, intrinsic stress, resonance and quality factor.

UNIT III	SENSING AND ACTUATION	9

Electrostatic sensing and actuation-Parallel plate capacitor – Application-Inertial, pressure and tactile sensor parallel plate actuator- comb drive. Thermal sensing and Actuations-Thermal Sensors-Actuators- Applications Inertial, flow and infrared sensors. Piezo resistive sensors- piezo resistive sensor material- stress in flexural cantilever and membrane-Application-Inertial, pressure, flow and tactile sensor. Piezoelectric sensing and actuation-piezoelectric material properties-quartz-PZT-PVDF –ZnO- Application-Inertial, Acoustic, tactile, flow-surface elastic waves Magnetic actuation- Micro magnetic actuation principle-Deposition of magnetic materials-Design and fabrication of magnetic coil.

UNIT IV	BULK AND SURFACE MICROMACHINING	9

Anisotropic wet etching, Dry etching of silicon, Deep reactive ion etching (DRIE), Isotropic wet etching, Basic surface micromachining process- structural and sacrificial material, stiction and ant stiction methods, Foundry process.

UNIT V	POLYMER AND OPTICAL MEMS	9
Polymers in MEMS- polymide-SU-8 Liquid crystal polymer (LCP)-PDMS-PMMA-Perylene- Fluorocarbon, Application-Acceleration, pressure, flow and tactile sensors. Optical MEMS-passive MEMS optical components-lenses-mirrors-Actuation for active optical MEMS.		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Analyse MEMS and microfabrication.
2.	Describe the different properties of MEMS materials.
3.	Describe the concept of sensing and actuation.
4.	Explain bulk and surface machining.
5.	Utilize polymer and optical MEMS.

TEXT BOOKS:	
1.	Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2.	*Stephen D. Senturia, "Microsystem Design", Kluwar Academic Publishers.*
3.	*Tai- Ran Hsu, "MEMS and Microsystems Design, Manufacture and Nanoscale Engineering", John Wiley and Sons.*

REFERENCES:	
1.	*Gaberiel M. Rebiz, "RF MEMS Theory,Design and Technology", John Wiley & Sons,2003*
2.	*Charles P. Poole, Frank J. Owens, "Introduction to Nanotechnology" John Wiley & Sons, 2003.*
3.	*JulianW.Gardner, Vijay K Varadhan, "Microsensors, MEMS and Smart Devices", John Wiley & sons,2001.*
4.	*Richard Layton, Thomas McConnell Adams, "Introductory MEMS Fabrication and Applications", Springer series.*
5.	*Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**3**	**-**	**-**	**3**	**-**	**-**
CO2	**-**	**2**	**3**	**-**	**1**	**1**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**
CO3	**-**	**-**	**2**	**3**	**-**	**-**	**2**	**-**	**3**	**2**	**1**	**2**	**1**	**1**	**3**
CO4	**2**	**2**	**1**	**1**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO5	**1**	**3**	**3**	**2**	**-**	**-**	**2**	**2**	**1**	**1**	**3**	**-**	**3**	**3**	**1**
20LPE016	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE017	NANO ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn and understand basic concepts of Nano electronics.
- To know the techniques of fabrication and measurement.
- To gain knowledge about Nanostructure devices and logic devices.

UNIT I	LIMITATIONS OF CMOS	9

Fundamentals of MOSFET devices - Scaling of CMOS – Limitations – Alternative concepts in materials – **Structures of MOS devices:** SOI MOSFET, FINFETS, Dual Gate MOSFET, Ferro electric FETs.

UNIT II	MICRO AND NANO FABRICATION	9

Optical Lithography – Electron beam Lithography – Atomic Lithography – Molecular beam epitaxy – Nano lithography.

UNIT III	CHARACTERIZATION EQUIPMENTS	9

Principles of Electron Microscopes – Scanning Electron Microscope – Transmission Electron Microscope -Atomic Force Microscope – Scanning Tunneling Microscope.

UNIT IV	NANODEVICES – I	9

Resonant tunneling diodes – Single electron devices – Josephson junction – Single Flux Quantum logic –Molecular electronics.

UNIT V	NANO DEVICES – II	9

Quantum **computing**: principles – Qrbits – Carbon nanotubes (CNT): Characteristics, CNTFET, Application of CNT - Spintronics: Principle, Spin valves, Magnetic Tunnel Junctions, Spin FETs, MRAM.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	To describe the limitations of CMOS

2.	To analyse the micro and nano fabrication techniques.
3.	To work with characterisation equipments
4.	To be exposed to nano devices
5.	To be exposed to principles of Quantum computing nano devices

TEXT BOOKS:	
1.	Mark Ratner and Daniel Ratner , " Nanotechnology : A Gentle Introduction to the Next Big Idea", Pearson education, 2003.
2.	Seng Ghee Tan and Mansoor B. A. Jalil, "Introduction to the Physics of Nanoelectronics", Woodhead Publishing.
3.	Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio,"Introduction to Nanoelectronics Science, Nanotechnology, Engineering and Appliances", Cambridge University press.

REFERENCES:	
1.	*Marc Baldo, "Introduction to Nanoelectronics".*
2.	*ThomasHeinzel , "A Microscopic Electronics in Solid State Nanostructure" , Wiley- VCH.*
3.	RainerWaser (Ed.) , "Nano electronics and information technology", Wiley- VCH., Edition II, 2005.
4.	*Mick Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse "Nanotechnology – (Basic Science and Emerging Technologies)", Overseas Press.*
5.	*Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, JanDienstuhl and others.*

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
CO3	**2**	**-**	**1**	**2**	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**3**	**2**
CO4	**-**	**3**	**2**	**1**	**-**	**3**		**1**	**1**	**1**	**-**	**-**	**1**	**2**	**3**
CO5	**3**	**3**	**2**	**1**	**3**	**3**	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**2**	**3**
20LPE017	**1**	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE018	OPTOELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the different properties of light and light sources
- To know the operation of optical sources and detectors.
- To have a knowledge about optical modulation and optoelectronic integrated circuits.

UNIT I	ELEMENTS OF LIGHT AND SOLID-STATE 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	DISPLAY DEVICES AND LASERS	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 DETECTION DEVICES	9

Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.

UNIT IV	OPTOELECTRONICMODULATOR	9

Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, Switching and Logic Devices.

UNIT V	OPTOELECTRONIC INTEGRATED CIRCUITS	9

Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

	TOTAL:45PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	discuss about different nature of light
2.	Explain the operation of optical sources
3.	Explain the operation of optical detectors.
4.	Compare different optical modulations
5.	Discuss about optoelectronic integrated circuits.

TEXT BOOKS:	
1.	Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
2.	Jasprit Singh, "Opto Electronics – As Introduction to Materials and Devices", Mc Graw-Hill International Edition, 1998

REFERENCES:	
1.	*Kasap Safa, "Optoelectronics and Photonics: Principles and Practices", Pearson Education.*
2.	*S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005.*
3.	*J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall, 1995*
4.	*Emmanuel Rosencher, Borge Vinter, "Optoelectronics", Cambridge University Press.*
5.	*Michael A. Parker,"Physics of Optoelectronics", CRC Taylor and Francis.*

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	-	-	-	-	-	-	-	-	2	2	1	1
CO2	1	-	-	1	-	-	-	-	-	-	-	2	2	2	1
CO3	1	-	-	1	-	-	-	-	-	-	-	2	2	2	1
CO4	2	1	-	1	-	-	-	-	-	-	-	2	2	2	1
CO5	1	-	-	1	-	-	-	-	-	-	-	2	2	2	1
20LPE018	1	-	-	1	-	-	-	-	-	-	-	2	2	2	1

1-Low 2—Moderate (Medium) 3-High

20LPE019	RADAR SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation

UNIT I INTRODUCTION TO RADAR EQUATION 9

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations

UNIT II MTI AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics -Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).

UNIT III DETECTION OF SIGNALS IN NOISE 9

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays

Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter. - The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

UNIT IV	RADIO DIRECTION AND RANGES	9
Introduction - Four methods of Navigation. - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments. **Hyperbolic Systems of Navigation (Loran and Decca) -** Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System		
UNIT V	**SATELLITENAVIGATION SYSTEM**	**9**
Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment - Instrument Landing System - Ground Controlled Approach System - Microwave Landing System (MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation Over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning System (GPS)		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Derive and discuss the Range equation and the nature of detection.
2.	Discuss about Doppler Radar and various tracking techniques
3.	Discuss about various Radar antennas, transmitters and receivers.
4.	Explain principles of navigation, in addition to approach and landing aids as related to navigation
5.	Describe about the navigation systems using the satellite.

TEXT BOOKS:	
1.	Merrill I. Skolnik ," Introduction to Radar Systems", 3rd Edition Tata Mc Graw-Hill 2003.
2.	N.S.Nagaraja, “Elements of Electronic Navigation Systems”, 2nd Edition, TMH, 2000.
3.	Paul A. Lynn, "Radar Systems", Macmillan New Electronic Series, Van Nostrand Reinhold.

REFERENCES:	
1.	*Peyton Z. Peebles: "Radar Principles", John Wiley, 2004*
2.	*J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004*
3.	*Bassern R. Mahafza, "Radar Systems Analysis and Design using MATLAB", Chapman & Hall / CRC Press.*
4.	*Shan Quegan, Simon Kingsley, "Understanding Radar Systems", Scitech Publishing.*

COURSE ARTICULATION MATRIX:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	_	_	_	_	_	_	_	_	2	3	3	1
CO2	3	3	2	_	_	_	_	_	_	_	_	3	3	3	1
CO3	3	2	1	_	_	_	_	_	_	_	_	3	3	3	1
CO4	3	2	2	_	_	_	_	_	_	_	_	3	2	2	1
CO5	2	3	2	_	_	_	_	_	_	_	_	2	2	2	1
20LPE019	3	2	2	_	_	_	_	_	_	_	_	3	3	3	1

1-Low 2—Moderate (Medium) 3-High

20LPE020	SMART ANTENNAS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the fundamental of Smart antennas.
- To understand the Spatial Spectrum of the antenna array and analyze the performance of smart antenna using beamforming techniques
- Gain an understanding and experience with smart antenna environments and implementation.

UNIT I	INTRODUCTION TO SMART ANTENNAS	9

Need for Smart Antennas, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Mutual Coupling Effects

UNIT II	DOA ESTIMATION FUNDAMENTALS	9

Introduction the Array Response Vector, Received Signal Model, The SubspaceBased Data Model, Signal Autocovariance Matrices, Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, The MUSIC Algorithm, The ESPRIT Algorithm, Uniqueness of DOA Estimates.

UNIT III	BEAM FORMING FUNDAMENTALS	9

The Classical Beam former-Statistically Optimum Beam forming Weight Vectors, The Maximum SNR Beam former, The Multiple Side lobe Canceller and the Maximum, SINR Beam former- Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV) , Adaptive Algorithms for Beam forming, The Least Mean-Square (LMS) Algorithm, The Recursive Least Squares (RLS) Algorithm.

UNIT IV	SPACE TIME PROCESSING	9

Introduction, Discrete Space–Time Channel and Signal Models, Space–Time Beam forming, Intersymbol and Co-Channel Suppression, ISI Suppression, CCI Suppression, Joint ISI and CCI Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Single-User Data Rate Limits, Multiple Users Data Rate Limits, Data Rate Limits Within a Cellular System, MIMO in Wireless Local Area Networks.

UNIT V	MOBILE STATIONS SMART ANTENNAS	9
Introduction -Multiple-Antenna MS Design, Combining Techniques, Selection (Switched) Diversity, Maximal Ratio Combining, Adaptive Beam forming or Optimum Combining, RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements, Downlink Capacity Gains		
	TOTAL:45PERIODS	

COURSE OUTCOMES:	Upon the course completion, the student will have the ability to
1.	Explain the concept of fundamental Smart Antenna System.
2.	Analyse and calculate the direction relative to the array where the sound source is located, with help of MUSIC and ESPRIT Algorithm.
3.	Explain the beamforming techniques is used for detect and estimate the signal of interest at the output of a sensor array by means of optimal spatial filtering and interference rejection.
4.	Analyse the concepts of space time processing
5.	Evaluate the requirements for the design and implementation of smart antenna systems.

TEXT BOOKS:	
1.	Constantine A. Balanis & Panayiotis I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publishers series-2007
2.	Joseph C. Liberti Jr., Theodore S Rappaport, "Smart Antennas for Wireless CommunicationsIS-95 and Third Generation CDMA Applications", PTR – PH publishers, 1st Edition, 1989.
3.	Smart Antennas, By Lal Chand Godara, CRC Press

REFERENCES:	
1.	*M.J. Bronzel, Smart Antennas, John Wiley, 2004*
2.	*R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001*
3.	*Tapan K. Sarkar, Michael C. Wicks, Magdalena Salazar-Palma, Robert J. Bonneau, "Smart Antennas" Wiley series.*
4.	*Ahmed El Zooghby, "Smart Antenna Engineering", Artech House Publisher*
5.	*Chen sun, Jun Cheng, Takashi Ohira, "Handbook on Advancements in Smart Antenna Technologies for Wireless Networks", Information Science Reference*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	1	-	-	-	-	1	2	3	1	2
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	3	3
CO3	3	3	3	3	2	1	-	-	-	-	2	2	3	3	3
CO4	3	3	3	3	1	1	-	-	-	-	2	3	3	3	3
CO5	3	2	2	2	1	1	-	-	-	-	3	3	3	2	3
20LPE020	3	3	3	3	1	2	-	-	-	-	2	2	3	3	3

20LPE021	WAVELET TRANSFORMS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basics of signal representation and Fourier theory
- To understand Multi Resolution Analysis and Wavelet concepts
- To understand the design of wavelets using Lifting scheme and the applications of Wavelet transform

UNIT I	FUNDAMENTALS	9

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT II	MULTI RESOLUTION ANALYSIS	9

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.

UNIT III	CONTINUOUS WAVELET TRANSFORMS	9

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.

UNIT IV	DISCRETE WAVELET TRANSFORM	9

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT – MultiBand Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.

UNIT V	APPLICATIONS	9
Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding – Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions –Edge Detection and Object Isolation, Image Fusion, and Object Detection.		
		TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Use Fourier tools to analyse signals
2.	Gain knowledge about MRA and representation using wavelet bases
3.	Acquire knowledge about various wavelet transforms and design wavelet transform
4.	Apply wavelet transform for various signal & image processing applications
5.	To analyze Wavelet methods for signal processing and Image Compression Techniques

TEXT BOOKS:	
1.	Rao R M and A S Bopardikar, ―Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.
2.	L.Prasad&S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

REFERENCES:	
1.	*J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" WileyInterscience Publication,John Wiley & Sons Inc., 1999.*
2.	*M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.*
3.	*Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.*
4.	*Soman K P and Ramachandran K I, Insight into Wavelets from Theory to practice, Prentice Hall, 2004.*
5.	*L.Prasad & S.S.Iyengar, "Wavelet Analysis with Applications to Image Processing", CRC Press, 1997.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**2**	**-**	**-**
CO2	**2**	**1**	**-**	**1**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO3	**1**	**1**	**-**	**2**	**2**	**3**	**1**	**1**	**1**		**-**	**-**	**-**	**3**	**2**
CO4	**-**	**-**	**2**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**
CO5	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**
20LPE021	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**-**	**-**	**1**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE022	VLSI TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:	
•	To introduce the mathematical principles for systematic test and validation.
•	To introduce the scientific principles for systematic test and validation.
•	To instil knowledge on various testing algorithms

UNIT I	TESTING AND FAULT MODELLING	9

Introduction to testing – Faults in Digital Circuits – Modelling of faults – Logical Fault Models –Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation –Delay models – Gate Level Event – driven simulation.

UNIT II	TEST GENERATION	9

Test generation for combinational logic circuits – Testable combinational logic circuit design – Test generation for sequential circuits – design of testable sequential circuits.

UNIT III	DESIGN FOR TESTABILITY	9

Design for Testability – Ad-hoc design – generic scan-based design – classical scan-based design– system level DFT approaches.

UNIT IV	SELF – TEST AND TEST ALGORITHMS	9

Built-In self-Test – test pattern generation for BIST – Circular BIST – BIST Architectures – Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs.

UNIT V	FAULT DIAGNOSIS	9

Logical Level Diagnosis – Diagnosis by UUT reduction – Fault Diagnosis for Combinational Circuits– Self-checking design – System Level Diagnosis.

TOTAL: 45PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Discuss about the various faults in VLSI circuits.
2.	Analyze test generation of combinational and sequential circuits.
3.	Understand the principles used in the construction VLSI Design for Test (DFT) tools.
4.	Discuss about test pattern generation and BIST architectures.
5.	Diagnose the various faults in combinational circuits.

TEXT BOOKS:	
1.	M.Abramovici, M.A.Breuer and A.D. Friedman, “Digital systems and Testable Design”, Jaico Publishing House, 2002
2.	P.K. Lala, “Digital Circuit Testing and Testability”, Academic Press, 2002.
REFERENCES:	
1.	*M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2002.*
2.	*A.L.Crouch, “Design Test for Digital IC’s and Embedded Core Systems”, Prentice Hall International, 2002.*
3.	*T. W. Williams, "VLSI Testing", North- Holland.*
4.	*Laung-Teng Wang, Chang-Wen Wu Xiaoqing Wen, "VLSI Test Principles and Architectures: Design for Testablity", Morgan Kaufmann series.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	_	_	_	_	_	_	_	2	2	2	1
CO2	3	3	2	2	_	_	_	_	_	_	_	2	2	2	2
CO3	3	2	2	2	_	_	_	_	_	_	_	3	2	2	1
CO4	3	2	1	1	_	_	_	_	_	_	_	2	2	2	1
CO5	3	3	2	2	_	_	_	_	_	_	_	2	2	2	2
20LPE022	3	2	2	2	_	_	_	_	_	_	_	2	2	2	1

1-Low 2—Moderate (Medium) 3-High

20LPE023	ARM SYSTEM DESIGN	L	T	P	C
		3	0	0	3

UNIT I	ARM MICROCONTROLLER ARCHITECTURE	9

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing.

UNIT II	ARM ARCHITECTURE AND PROGRAMMING	9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures -- The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Coprocessors. Instruction set – Thumb instruction set – Instruction cycle timings

UNIT III	ARM APPLICATION DEVELOPMENT	9

Introduction to DSP on ARM – Filter –Exception Handling – Interrupts – Interrupt handling schemes Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components – Example- ARM Cortex M0 NUVOTON Processor.

UNIT IV	MEMORY PROTECTION AND MANAGEMENT	9

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

UNIT V	DESIGN WITH ARM MICROCONTROLLER	9

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division- Negation Simple Loops –Look up table- Block copy- subroutines.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	To learn the IO peripherals, communication and interfacing techniques of ARM
2.	To understand the ARM architecture its instruction set
3.	To develop application using ARM cortex
4.	To implement memory management technique.
5.	To design systems and programming using ASM and C programs

TEXT BOOKS:	
1.	Andrew N.Sloss, Dominic Symes and Chris Wright " ARM System Developer's Guide : Designing and Optimizing System Software" , First edition, Morgan Kaufmann Publishers, 2004.
2.	Steve Furber, 'ARM system on chip architecture', Addision Wesley,2010.
3.	David Seal, "ARM Architecture Reference Manual" Second Edition, Addison-Wesley Professional, 2001.
REFERENCES:	
1.	*Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,*
2.	*Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001*
3.	*William Hohl, 'ARM Assembly Language' Fundamentals and Techniques,2009.*
4.	*Jason D. Bakos, "Embedded Systems ARM programming and optimization",Morgan Kaufmann Publishers.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	3	3
CO3		2	3	3	2	2	2	2	2	2	2	-	2	3	
CO4	1	2	3	1	2	2	1	-	-	2	-	-	2	2	2
CO5		2	3	3	3	2	2	2	2	2	3	2	3	3	3
20LPE023	1	2	2	1	1	1	1	-	-	1	1	-	2	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE024	ANALOG INTEGRATED CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the MOSFET theory, its second order effects, digital and analog metrics of MOS device.
- To Analyse frequency response of single and two stage amplifiers
- To study the operation of current mirrors and operational amplifiers circuits

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, Digital metrics, Analog metrics, 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, poles and zeros

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, Noise, Output stage, OTA and OPAMP circuits - Low voltage OPAMP		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Ability to explain the operation of MOSFET and its metrics
2.	Ability to analyse the single and two stage amplifiers
3.	Ability to analyse the frequency response of single and two stage amplifiers
4.	Ability to understand the operation of current mirror and reference circuits
5.	Ability to understand the operation of operational amplifiers

TEXT BOOKS:	
1.	Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2000
2.	Paul R.Gray, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley Student edition, 5th edition, 2009.
3.	J. Michael Jacob, "Applications and Design with Analog Integrated circuits", Second Baker, PHI, 1996.

REFERENCES:	
1.	*Philip E.Allen, "CMOS Analog Circuit Design", Oxford University Press, 2013*
2.	*David Harris, Neil Weste, "CMOS VLSI design: A Circuits and Design Perspective", Pearson.*
3.	*R.Jacob Baker, "CMOS: Circuit Design, Layout , and Simulation", Wiley Student Edition, 2009*
4.	*David A. Jones, Kenneth W Martin Tony Chan Carusone," Analog Integrated Circuit Design" Wiley, 2013*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO2	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO3	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO4	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO5	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
20LPE024	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LPE025	MICROWAVE INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce microwave circuits
- To understand the design of matching networks, filters, amplifiers, oscillators and mixer circuits.
- To study about microwave integrated circuits.

UNIT I	INTRODUCTION TO MICROWAVE CIRCUITS	9

Definitions – Frequency Bands – Lumped versus Distributed Circuits - Behavior of finite length transmission lines – General Characteristics of PC Boards – Transmission Lines on PC Boards – Passives made from Transmission Lines – Resonators - Combiners, Splitters and Couplers

UNIT II	MATCHING NETWORKS AND FILTER DESIGN	9

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements, Filter design.

UNIT III	AMPLIFIERS AND OSCILLATORS	9

Amplifiers: Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Low Noise Amplifier Design, Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.

UNIT IV	MIXERS AND CONTROL CIRCUITS	9

Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers - Sub Harmonic Diode Mixers, Microwave Diodes, Phase Shifters – PIN Diode Attenuators

UNIT V	MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES	9
Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Describe microwave circuits and printed circuit boards.
2.	Design matching networks and filters.
3.	Analyse microwave amplifiers and oscillators
4.	Compare different mixer circuits.
5.	Discuss about microwave integrated circuits design and measurement techniques.

TEXT BOOKS:	
1.	Thomas H.Lee, "Planar Microwave Engineering", Cambridge University Press, 2004
2.	Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, II Edition 2002

REFERENCES:	
1.	*"Microwave Transistor Amplifiers – Analysis and Design", II Edition, Prentice Hall, New Jersy*
2.	*Ravender Goyal, "Monolithic MIC; Technology & Design", Artech House, 1989.*
3.	*Gupta K.C. and Amarjit Singh, "Microwave Integrated Circuits", John Wiley, New York, 1975.*
4.	*Hoffman R.K. "Handbook of Microwave Integrated Circuits", Artech House, Boston, 1987.*
5.	*Ulrich L. Rohde and David P.N., "RF / Microwave Circuit Design for Wireless Applications", John Wiley, 2000.*
6.	*C. Gentili, "Microwave Amplifiers and Oscillators", North Oxford Academic, 1986.*
7.	*Samuel. Y. Liao, "Microwave Circuit Analysis and Amplifier Design", Prentice Hall. Inc., 1987.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	2	2	2	2
CO2	3	2	3	1	-	-	-	-	-	-	-	2	2	2	2
CO3	3	2	3	-	2	-	-	-	-	-	-	2	3	3	2
CO4	3	2	3	1	-	-	-	-	-	-	-	2	2	2	2
CO5	3	2	3	-	2	-	-	-	-	-	-	2	3	3	2
20LPE025	3	2	3	1	1	-	-	-	-	-	-	2	2	2	2

1-Low 2—Moderate (Medium) 3-High

OPEN ELECTIVES

20LOE001	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand Concept of Real time system
- Understand the Design and application programs on real time systems
- Understand the hardware and software architectures of real time Systems.

UNIT I	INTRODUCTION	9

Introduction – Issues in Real Time Computing – Structure of a Real Time System – Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms – Uniprocessor scheduling of IRIS tasks – Task assignment – Mode changes and Fault Tolerant Scheduling.

UNIT II	PROGRAMMING LANGUAGES AND TOOLS	9

Programming Languages and Tools – Desired language characteristics – Data typing – Control structures – Facilitating Hierarchical Decomposition, Packages, Run time (Exception) Error handling – Overloading and Generics – Multitasking – Low level programming – Task Scheduling – Timing Specifications – Programming Environments – Run – time support.

UNIT III	REAL TIME DATABASES	9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT IV	COMMUNICATION	9

Real – Time Communication – Communications media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types – Fault Detection. Fault Error containment Redundancy – Data Diversity – Reversal Checks – Integrated Failure handling.

UNIT V	EVALUATION TECHNIQUES	9
Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Non-fault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware –Fault Tolerant Synchronization in software.		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Understand the scheduling problems and can apply them in real time system.
2.	Describe the foundation for programming languages developed for real time programming.
3.	Be exposed to real time database.
4.	Establish real time communication between devices
5.	Analyse the situation of fault occurrence and will be able to apply solutions accordingly.

TEXT BOOKS:	
1.	C.M. Krishna, Kang G. Shin, "Real – Time Systems", McGraw – Hill International Editions, 1997.
2.	Rajib Mall," Real-time systems: theory and practice", Pearson Education, 2007
3.	Peter D.Lawrence, "Real Time Micro Computer System Design – An Introduction", McGraw Hill, 1988.

REFERENCES:	
1.	*Stuart Bennett, "Real Time Computer Control – An Introduction", Prentice Hall ofIndia, 1998.*
2.	*S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan,2nd Edition, 1987.*
3.	*R.J.A Buhur, D.L Bailey, "An Introduction to Real – Time Systems", Prentice – HallInternational, 1999.*
4.	*Philip.A.Laplante, "Real Time System Design and Analysis", Prentice Hall of India, 3rdEdition, April 2004*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	-	3	2	3	3	3	3	3
CO2	3	3	3	2	3	-	-	-	3	3	2	3	3	3	3
CO3	2	1	1	-	-	2	1	-	-	2	2	2	3	2	3
CO4	2	1	1	-	3	2	1	-	2	2	1	3	3	2	2
CO5	3	3	3	3	3	1	2	-	3	3	1	3	3	3	3
20LOE001	2	2	2	1	2	1	1	-	1	2	1	2	3	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE002	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

•	To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology.
•	Understand the medium access control protocols and address physical layer issues
•	Knowledge of infrastructure establishment and sensor network platform is provided

UNIT I	OVERVIEW OF WIRELESS SENSOR NETWORKS	9

Challenges for Wireless Sensor Networks, 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.

UNIT III	NETWORKING SENSORS	9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT IV	INFRASTRUCTUREESTABLISHMENT	9

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V	SENSOR NETWORK PLATFORMS AND TOOLS	9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

	TOTAL:45PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Describe enabling Technologies for Wireless Sensor Networks,
2.	Analyse the architecture of sensor networks and design principles for WSNs, Service interfaces of WSNs, Gateway concepts
3.	Design protocols for wireless sensor networks with respect to some protocol design issues
4.	Describe the infrastructure establishment in Sensor networks.
5.	Analyse the sensor network platforms and tools.
TEXT BOOKS:	
1.	Holger Karl & Andreas Willig, " Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2.	Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
REFERENCES:	
1.	*KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, And Applications", John Wiley, 2007.*
2.	*AnnaHac, "Wireless Sensor Network Designs", John Wiley, 2003*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	2	-	-	1	2	1	3	3	2	3
CO2	3	3	3	2	1	2	2	1	3	2	2	3	3	3	2
CO3	3	3	3	2	2	2	-	-	3	2	2	3	3	2	3
CO4	2	1	2	-	2	2	2	1	2	2	3	2	3	3	2
CO5	3	2	3	2	3	2	1	-	3	3	2	3	3	3	3
20LOE002	2	2	2	1	1	2	1	-	2	2	2	2	3	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE003	INDUSTRIAL AUTOMATION AND ROBOTICS	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO ROBOTICS AND AUTOMATION	9

Robotics**:** History of Robotics, Applications of Robotics, General Structure of Robotic Mechanical Systems, Classification of Robots based on coordinate system, Classification of Robotics, Overview of robot subsystems, Components of Robot system-Manipulator, Controller, Power conversion unit etc, Specifications of robot. Commercially available Software Packages for Robot Simulation

UNIT II	KINEMATICS AND DYNAMICS	12

Kinematics: Homogeneous co-ordinate vector operations, matrix operations, co-ordinate reference frames, Homogeneous transformation and manipulator orientation relative points reference frames, Workspace , Forward Kinematics - forward solutions- Link coordinate frames, D-H matrix, Inverse Kinematics - Existence and Uniqueness of Solutions, **Dynamics**: Kane's Method in Robotics - Two DOF Planar Robot with Two Revolute Joints, Generalized Coordinates and Speeds, Velocities, Partial Velocities, Accelerations, Generalized Inertia Forces, Generalized Active Forces

UNIT III	MECHANISMS ACTUATORS AND SENSORS	9

Some Popular **Mechanisms** - Four-bar Mechanism, Slider-crank Mechanism, Rack and Pinion, Cams and Cranks, Gear and Gear Trains, Kinematics and Kinetics, Serial Robots, Parallel Robots, Mechanical Structure, Joint Mechanisms.

Actuators: Electromagnetic Actuators, Fluid Power Actuators. Different types of grippers - Compressed Air, Vacuum, Hydraulic Fluid Power, Electrical Power & other methods of gripping. DC Motors, Stepper Motors, Servo Motor, Controlling of these motors.

UNIT IV	SENSORS	7

Sensors: Encoders - Rotary and Linear Incremental Encoders, Tachometer, Quadrature Encoders, Absolute Encoders. Analog Displacement Sensors, Force and Tactile Sensors, Ultrasonic Transponder, Accelerometers, Gyroscopes, proximity sensors, Infrared Sensors, touch slip sensor, laser range finder, Vision-based Sensors, Color-tracking Sensors, Sensor Mounting Arrangement.

UNIT V	AUTOMATION	8
Structure of Automatic Industrial Systems, Relationship between the Robot Intelligence and the Product, Productivity of a Manufacturing Process, Kinematics and Control of Automatic Machines, Feedback Sensors, Transporting Devices, Feeding and Orientation Devices, Automatic Assembling, Inspection Systems, Welding _ Automation.		
	TOTAL:45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	To learn the basic concepts of working of robot and its fields
2.	To know about the dynamics and kinematics of robot
3.	To understand the functions and mechanisms of actuators in the robot
4.	To study about the working of sensors and its applications
5.	To know about the use of Robots in industrial applications

TEXT BOOKS:	
1.	Bruno Siciliano, Oussama Khatib (Eds.), _Springer Handbook of Robotics_, 2008,
2.	Jorge Angeles, _Fundamentals of Robotic Mechanical Systems Theory, Methods, and Algorithms_ Second Edition, 2003, Springer-Verlag New York, Inc.,
3.	Edwin Wise, _Robotics Demystified_, 2005, The McGraw-Hill Companies,

REFERENCES:	
1.	*Thomas R. Kurfess, _Robotics and Automation Handbook_, CRC Press, 2004,*
2.	*_Robotics: Appin Knowledge Solutions (Firm)_, Infinity Science Press, 2007,*
3.	*J. Norberto Pires, Altino Loureiro and Gunnar Bölmsjo, _Welding Robots - Technology, System Issues and Applications_, Springer-Verlag 2006,*
4.	*J.G Proakis, "Digital Communication", 4th Edition, Tata Mc Graw Hill Company, 2001.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
CO2	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-s**
CO3	**3**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**--**	**2**	**2**	**2**
CO5	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**2**	**-**	**2**	**2**	**2**	**3**	**3**	**3**
20LOE003	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE004	PRINCIPLES OF VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Explain electrical properties of MOS and analyse the CMOS technology.
- Provide concept of combinational and sequential circuits
- Understand the basic of VHDL and verilog for different logic circuits

UNIT I	CMOS TECHNOLOGY	9

A brief History-MOS transistor, Ideal I-V characteristics, C-V characteristics, Non-ideal IV effects, DC transfer characteristics - CMOS technologies, Layout design Rules, CMOS process enhancements, Technology related CAD issues, Manufacturing issues

UNIT II	CIRCUIT CHARACTERIZATION AND SIMULATION	9

Delay estimation, Logical effort and Transistor sizing, Power dissipation, Interconnect, Design margin, Reliability, Scaling- SPICE tutorial, Device models, Device characterization, Circuit characterization, Interconnect simulation

UNIT III	COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN	9

Circuit families –Low power logic design – comparison of circuit families – Sequencing static circuits, circuit design of latches and flip flops, Static sequencing element methodology- sequencing dynamic circuits – synchronizers

UNIT IV	CMOS TESTING	9

Need for testing- Testers, Text fixtures and test programs- Logic verification- Silicon debug principles- Manufacturing test – Design for testability – Boundary scan

UNIT V	SPECIFICATION USING VERILOG HDL	9

Basic concepts- identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments conditional statements, Data flow and RTL, structural gate level switch level modelling, Design hierarchies, Behavioural and RTL modelling, Test benches, Structural gate level description of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop.

	TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Explain the basics of CMOS circuits.
2.	To understand the CMOS process technology.
3.	To understand the concepts of designing VLSI subsystems.
4.	Be exposed to techniques of chip design using programmable devices.
5.	Modelling of digital system using hardware description language.
TEXT BOOKS:	
1.	Weste and Harris: CMOS VLSI DESIGN (Third edition) Pearson Education, 2005
2.	J.Bhasker: Verilog HDL primer, BS publication,2001
REFERENCES:	
1.	*Uyemura J.P: Introduction to VLSI circuits and systems, Wiley 2002.*
2.	*D.A Pucknell & K.Eshraghian Basic VLSI Design, Third edition, PHI, 2003*
3.	*M.J.S.Smith: Application specific integrated circuits, Pearson Education, 1997*
4.	*Ciletti Advanced Digital Design with the Verilog HDL, Prentice Hall of India, 2003*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO2	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO3	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO4	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
CO5	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2
20LOE004	-	3	3	3	1	2	2	-	-	3	2	2	2	3	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE005	APPLIED ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn and understand basic concepts of Applied electronics.
- To learn the design, construction, and debugging of analog electronic circuits.
- To develop skill in simple applications development with programming 8085 & 8051

UNIT I	ANALOG CIRCUITS	9

Overview on semiconductors, diodes, transistor switches, capacitors, fields and inductors – BJT amplifiers, JFET amplifiers, MOSFET amplifiers.

UNIT II	APPLICATION OF ANALOG CIRCUITS	9

Operational amplifiers, application of op-amps, active filters, 555 timer and oscillators – power amplifiers – power supplies.

UNIT III	DIGITAL CIRCUITS	9

Overview on logical circuits, logical operations, combinational and sequential circuits – display devices – converter circuits.

UNIT IV	ELECTRONIC COMMUNICATION SYSTEMS	9

Audio and video systems – noise – telecommunications – cable transmission, optical transmission – electronic control systems – process control systems.

UNIT V	MICROPROCESSORS AND MICROCONTROLLER	9

Input and output - microprocessors and programming - sensors and interfacing - The PIC microcontroller - circuit simulation – circuit construction.

TOTAL: 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Acquires knowledge for building, testing and modifying simple circuits to complex circuits.
2.	Ability to understand and analyse, linear and digital electronic circuits.
3.	Acquires the basic knowledge of electronics.
4.	Gains knowledge about the microprocessor and microcontroller.

TEXT BOOKS:	
1.	Owen Bishop, "Electronics – Circuits and Systems", 3 rd Edition, Newnes, 2010.
2.	Michael Tooley B A, "Electronic Circuits: Fundamentals and Applications", 3 rd Edition, Newnes, 2006.
3.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition,Tata Mc Graw Hill, 2009.
REFERENCES:	
1.	*John B.Peatman ," Design with PIC Microcontrollers", Prentice Hall, 1998.*
2.	*Jacob Millman, Christos C.Halkias, 'Integrated Electronics – Analog and Digital circuits system',Tata McGraw Hill, 2003.*
3.	*Fiore,"Opamps & Linear Integrated Circuits Concepts & Applications",Cengage,2010.*
4.	*R. Gayakwad , Textbook of Operational Amplifiers and Linear Integrated Circuits, PHI Publication.*
5.	*R. Coughlin and Driscoll, Textbook of OpAmp & Linear Integrated Circuits, PHI Publications.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	1	2	2	-	-	1	-	-
CO2	3	3	2	-	-	-	1	1	2	2	3	-	-	2	-
CO3	1	2	3	3	3	1	1	-	-	2	2	-	1	1	-
CO4	3	2	3	1	3		-	-	-	2	3	2	2	3	3
CO5	3	-	2	1	3	3	2	-	-	3	2	3	3	1	3
20LOE005	2	1	2	1	1	-	-	-	-	2	2	-	1	1	1

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE006	FUNDAMENTALS OF WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about Wireless networks, protocol stack and standards.
- To study about fundamentals of 3G Services, its protocols and applications.
- To study about evolution of 4G Networks, its architecture and applications.

UNIT I	WIRELESS LAN	9

Introduction-WLAN technologies: Infrared, UHF narrowband, spread spectrum - IEEE802.11: System architecture, protocol architecture, physical layer, MAC layer, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, Radio Layer, Baseband layer, Link manager Protocol, security - IEEE802.16-WIMAX: Physical layer, MAC, Spectrum allocation for WIMAX

UNIT II	MOBILE NETWORK LAYER	9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing, Destination Sequence distance vector, Dynamic source routing.

UNIT III	MOBILE TRANSPORT LAYER	9

TCP enhancements for wireless protocols - Traditional TCP: Congestion control, fast retransmit/fast recovery, Implications of mobility - Classical TCP improvements: Indirect TCP, Snooping TCP, Mobile TCP, Time out freezing, Selective retransmission, Transaction oriented TCP - TCP over 3G wireless networks.

UNIT IV	WIRELESS WIDE AREA NETWORK	9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3G-MSC, 3G-SGSN, 3G-GGSN, SMS-GMSC/SMS-IWMSC, Firewall, DNS/DHCP-High speed Downlink packet access (HSDPA)- LTE network architecture and protocol.

UNIT V	4G NETWORKS	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

TOTAL : 45 PERIODS

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Acquires knowledge about the latest 3G/4G and WiMAX networks and its architecture.
2.	Design and implement wireless network environment for any application using latest wireless protocols and standards.
3.	Implement different types of applications for smart phones and mobile devices with latest network strategies.
4.	An Overview of UTMS and its core network Architecture
5.	To describe the 4G features and challenges and its Applications of 4G
TEXT BOOKS:	
1.	Jochen Schiller," Mobile Communications", Second Edition, Pearson Education 2012. (Unit I, II, III)
2.	Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007. (Unit IV, V)
3.	William Stallings, "Wireless Communications and Networks", Pearson Education, 2002.
REFERENCES:	
1.	*Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.*
2.	*Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.*
3.	*Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013*
4.	*Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks",First Edition, Pearson Education, 2003.*
5.	*Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**1**	**-**	**2**	**-**	**-**
CO2	**2**	**1**	**-**	**1**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO3	**1**	**-**	**-**	**1**	**1**	**-**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**-**	**1**	**2**	**2**	**-**	**1**	**-**	**2**	**1**	**2**	**2**	**1**	**-**	**1**	**1**
CO5	**3**	**2**	**1**	**-**	**-**	**3**	**3**	**-**	**1**	**1**	**-**	**1**	**-**	**2**	**-**
20LOE006	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE007	FUNDAMENTALS OF IOT	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO IOT	9
Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT vs M2M.		
UNIT II	**IOT DESIGN METHODOLOGY**	**9**
IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.		
UNIT III	**BUILDING IOT WITH RASPBERRY PI**	**9**
Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services		
UNIT IV	**BUILDING IOT WITH GALILEO/ARDUINO**	**9**
Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks		
UNIT V	**CASE STUDIES and ADVANCED TOPICS**	**9**
Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT		
	TOTAL: 45 PERIODS	

OUTCOMES	Upon the course completion, the student will have the ability to
1.	Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
2.	Develop web services to access/control IoT devices.
3.	Deploy an IoT application and connect to the cloud.
4.	Analyse applications of IoT in real time scenario

TEXT BOOKS:	
1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2.	Hakima Chaouchi, “The Internet of Things Connecting objects to the web”, Wiley, 2017.
3.	Raj Kamal, “Internet of Things Architecture and Design Principles”, Tata McGraw Hill, 2017.

REFERENCES:	
1.	*Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.*
2.	*Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.*
3.	*Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2013.*
4.	*Samuel Greengard, "The Internet of Things", MIT press, 2015.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	1	-	-	-	-	-	-	-	-	-	2	3	3
CO3		2	3	3	2	2	2	2	2	2	2	-	2	3	-
CO4	1	2	3	1	2	2	1	-	-	2	-	-	2	2	2
CO5		2	3	3	3	2	2	2	2	2	3	2	3	3	3
20LOE007	1	2	2	1	1	1	1	-	-	1	1	-	2	2	2

1-LOW 2-MODERATE (MEDIUM) 3-HIGH

20LOE008	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn the various soft computing frame works
- Understand the design of various neural networks and fuzzy logics
- Gain the knowledge of advanced fuzzy logic techniques and its application.

UNIT I	INTRODUCTION	9

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II	NEURAL NETWORKS	9

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network –unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

UNIT III	FUZZY LOGIC	9

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT IV	GENETIC ALGORITHM	9

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem- advances in GA

UNIT V	HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS	9
Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES	Upon the course completion, the student will have the ability to
1.	Apply various soft computing frame works.
2.	Design of various neural networks.
3.	Use fuzzy logic.
4.	Apply genetic programming.
5.	Discuss hybrid soft computing.

TEXT BOOKS:	
1.	J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education 2004
2.	S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011
3.	Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI

REFERENCES:	
1.	*S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.*
2.	*George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.*
3.	*James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991*
4.	*Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.*
5.	*David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**-**	**-**	**1**	**-**	**-**
CO2	**3**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**1**	**-**	**2**	**-**
CO3	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**2**	**-**	**3**	
CO4	**-**	**-**	**2**	**3**	**3**	**2**	**-**	**3**	**1**	**1**	**2**	**-**	**-**	**3**	**3**
CO5	**-**	**3**	**2**	**2**	**3**	**2**	**-**	**3**	**1**	**1**	**1**	**-**	**-**	**2**	**3**
20LOE008	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**1**

1-LOW 2-MODERATE (MEDIUM) 3-HIGH