



NARAYANA ENGINEERING COLLEGE::GUDUR



AUTONOMOUS

B.Tech

E.C.E

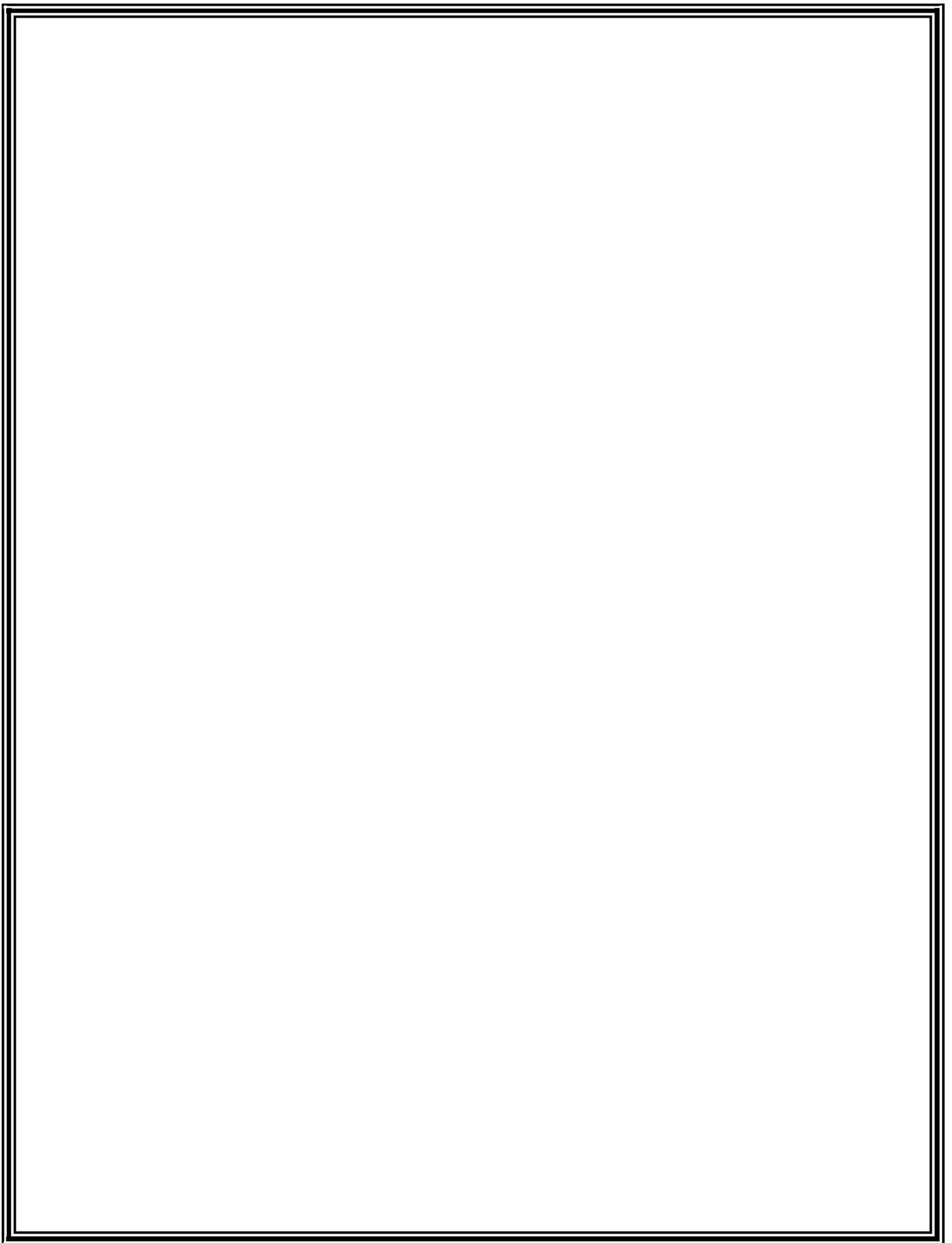
**Course Structure
&
Syllabus**

(w.e.f 2020-21 academic year)

(NECR B.Tech 20)



**NARAYANA
ENGINEERING COLLEGE
(AUTONOMOUS)**





DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision of the Department

- ❖ To produce technically competent Electronics & Communication Engineers with a motive to meet the needs of the industry and evolving society through advanced research, professional ethics and lifelong learning.

Mission of the Department

- ❖ To enrich the technical skills of the students through effective teaching-learning practices, continuous assessment methods and eminent faculty.
- ❖ To continuously enhance creative thinking, research ability and innovative skills of students through training on core and multidisciplinary technologies and skill enhancement programs.
- ❖ To inculcate leadership qualities, ethics, social responsibility and gratitude through outreach programs.

Program Outcomes (POs)

- 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 solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 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 assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 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 principles and apply these to one's own work, as a member and leader in a team, to manage projects and in 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.

Program Educational Objectives (PEOs)

- ❖ **PEO_1:** Attain the global and local opportunities and reach greater heights in their chosen profession by demonstrating technical expertise.
- ❖ **PEO_2:** Gain recognition by exhibiting problem solving expertise for addressing significant problems of industry and society.
- ❖ **PEO_3:** Become good leaders with ethics and support, contribute and encourage diversity and inclusiveness in their workplace and society.

Program Specific Outcomes (PSOs)

- ❖ **PSO_1: Responsive to ideas:** Apply the knowledge on core Electronics and Communication Engineering in order to develop skills to analyze, design and develop innovative solutions for the real world problems.
- ❖ **PSO_2: Domain Expertise:** To develop interpersonal skills to demonstrate proficiency using the latest hardware and software solutions by maintaining professional and societal responsibilities.



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Structure for B.Tech ECE w.e.f AY: 2020-21

SEMESTER I

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total marks
20MA1001	BS	Algebra and Calculus	3	1	0	4	4	40	60	100
20PH1001	BS	Applied Physics	3	0	0	3	3	40	60	100
20ES1001	ES	Problem Solving and Programming	3	0	0	3	3	40	60	100
20EN1001	HS	English	2	0	0	2	2	40	60	100
20PH1501	BS	Applied Physics Lab	0	0	3	3	1.5	40	60	100
20EN1501	HS	English Language Lab	0	0	3	3	1.5	40	60	100
20ES1502	ES	Electronics and Communication Engineering Workshop	0	0	2	2	1	40	60	100
20ES1505	ES	Engineering and IT Workshop	0	0	4	4	2	40	60	100
20ES1506	ES	Problem Solving and Programming Lab	0	0	3	3	1.5	40	60	100
20MC8001	MC	Mandatory course I	Induction Program							
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester				20 Points			
		Total	11	1	18	30	19.5	360	540	900

**SEMESTER II**

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total marks
20CH1001	BS	Chemistry	3	0	0	3	3	40	60	100
20MA1004	BS	Vector Calculus and Transforms	3	1	0	4	4	40	60	100
20ES1004	ES	Basic Electrical Engineering	3	0	0	3	3	40	60	100
20ES1007	ES	Introduction to Python Programming	2	0	0	2	2	40	60	100
20CH1501	BS	Chemistry Lab	0	0	3	3	1.5	40	60	100
20ES1509	ES	Basic Electrical Engineering Lab	0	0	2	2	1	40	60	100
20ES1504	ES	Engineering Graphics Lab	0	1	4	5	3	40	60	100
20ES1510	ES	Introduction to Python Programming Lab	0	0	2	2	1	40	60	100
20EN1502	HS	Oral Communication Skills Lab	0	0	2	2	1	40	60	100
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester				20 Points			
		Total	11	2	16	29	19.5	360	540	900



SEMESTER III

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1005	BS	Complex Analysis and Numerical Methods	3	0	0	3	3	40	60	100
20ES1011	ES	Data Structures	2	0	2	4	3	40	60	100
20ES1013	ES	Electronic Devices and Circuits	3	0	0	3	3	40	60	100
20EC2001	PC	Digital Logic Design	3	0	0	3	3	40	60	100
20EC2002	PC	Network Theory	3	0	0	3	3	40	60	100
20ES1516	ES	Electronic Devices and Circuits Lab	0	0	3	3	1.5	40	60	100
20EC2501	PC	Digital Logic Design Lab	0	0	3	3	1.5	40	60	100
20EC2502	PC	Network Theory Lab	0	0	3	3	1.5	40	60	100
20CD6001	SC	Career Competency Development I	0	0	2	2	1	40	60	100
20CC6001	SC	Value Added Course/ Certificate Course I	0	0	0	0	1	40	60	100
20MC8002-12	MC	Mandatory Course II	2	0	0	2	0	00	00	00
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	16	0	16	32	21.5	400	600	1000



SEMESTER IV

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EC2003	PC	Analog Electronics	3	0	0	3	3	40	60	100
20EC2004	PC	Control Systems	2	0	0	2	2	40	60	100
20EC2005	PC	Electromagnetic Theory and Transmission Lines	3	0	0	3	3	40	60	100
20EC2006	PC	Probability and Random Processes	3	0	0	3	3	40	60	100
20EC2007	PC	Signals and Systems	3	0	0	3	3	40	60	100
-	OE	Open Elective I	3	0	0	3	3	40	60	100
20EC2503	PC	Analog Electronics Lab	0	0	3	3	1.5	40	60	100
20EC2504	PC	MATLAB and Simulink Lab	0	0	2	2	1	40	60	100
20CD6002	SC	Career Competency Development II	0	0	2	2	1	40	60	100
20CC6002	SC	Value Added Course/ Certificate Course II	0	0	0	0	1	40	60	100
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	17	0	10	27	21.5	400	600	1000



SEMESTER V

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EC2008	PC	Analog and Digital Communications	3	0	0	3	3	40	60	100
20EC2009	PC	Linear IC Applications	3	0	0	3	3	40	60	100
20EC2010	PC	Microprocessors and Microcontrollers	3	0	0	3	3	40	60	100
-	OE	Open elective II	3	0	0	3	3	40	60	100
20EC4001-06	PE	Professional Elective I	3	0	0	3	3	40	60	100
20EC2505	PC	Analog and Digital Communications Lab	0	0	3	3	1.5	40	60	100
20EC2506	PC	Microprocessors and Microcontrollers Lab	0	0	3	3	1.5	40	60	100
20CD6003	SC	Career Competency Development III	0	0	2	2	1	40	60	100
20CC6003	SC	Value Added Course/ Certificate Course III	0	0	0	0	1	40	60	100
20EC7501	PR	Internship I/on job training/Com Ser Project	0	0	0	0	1.5	00	100	100
20MC8002-12	MC	Mandatory Course III	2	0	0	2	0	00	00	00
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester				20 Points			
		Total	17	0	10	28	21.5	360	640	1000



SEMESTER VI

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EC2011	PC	Digital Design using HDL	3	0	0	3	3	40	60	100
20EC2012	PC	Digital Signal Processing	3	0	0	3	3	40	60	100
-	OE	Open Elective III	3	0	0	3	3	40	60	100
20EC4007-12	PE	Professional Elective II	3	0	0	3	3	40	60	100
20EC4013-18	PE	Professional Elective III	3	0	0	3	3	40	60	100
20EC2507	PC	Digital Signal Processing Lab	0	0	3	3	1.5	40	60	100
20EC2508	PC	Integrated Circuits Lab	0	0	3	3	1.5	40	60	100
20EC2509	PC	Electronic Design Workshop	0	0	3	3	1.5	40	60	100
20CD6004	SC	Career Competency Development IV	0	0	2	2	1	40	60	100
20CC6004	SC	Value Added Course/ Certificate Course IV	0	0	0	0	1	40	60	100
		Counselling/ Mentoring	0	0	1	1	0	--	--	--
		Sports/ Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester						20 Points	
		Total	15	0	12	29	21.5	400	600	1000



SEMESTER VII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks			
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks	
20HS5001 -8	HS	Humanities and Social Science Elective	2	0	0	2	2	40	60	100	
20EC2013	PC	VLSI Design	3	0	0	3	3	40	60	100	
20EC2014	PC	Microwave and Optical Communications	3	0	0	3	3	40	60	100	
-	OE	Open Elective IV	3	0	0	3	3	40	60	100	
20EC4019-24	PE	Professional Elective IV	3	0	0	3	3	40	60	100	
20EC4025-30	PE	Professional Elective V	3	0	0	3	3	40	60	100	
20EC2510	PC	VLSI Design Lab	0	0	2	2	1	40	60	100	
20EC2511	PC	Microwave and Optical Communications Lab	0	0	3	3	1.5	40	60	100	
20CD6005	SC	Career Competency Development V	0	0	2	2	1	40	60	100	
20CC6501	SC	Skill Development Training	0	0	2	2	1	40	60	100	
20EC7502	PR	Internship II/on job training/Com Ser Project	0	0	0	0	1.5	00	100	100	
20MC8002-12	MC	Mandatory Course IV	2	0	0	2	0	00	00	00	
		Counselling/Mentoring	0	0	1	1	0	--	--	--	
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--	
		Activity Point Programme	During the Semester						20 Points		
		Total	19	0	12	31	23	400	700	1100	



SEMESTER VIII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20EC7503	PR	Project work, seminar and internship	0	0	0	0	12	60	140	200
		Activity Point Programme	During the Semester					20 points		
			0	0	0	0	12	60	140	200

Open Electives (OE) offered by ECE Department

S. No	Course Code	Subject
1	20EC3001	Image Processing
2	20EC3002	Embedded Systems
3	20EC3003	Nano Technology
4	20EC3004	VLSI Design
5	20EC3005	Sensors and Actuators
6	20EC3006	Internet of Things (IoT)
7	20EC3007	Microprocessors and Microcontrollers
8	20EC3008	Wireless Sensor Networks
9	20EC3009	Microprocessor and Interfacing
10	20EC3010	Data Communication and Networks
11	20EC3011	Digital Logic Design
12	20EC3012	Principles of Communication

PROFESSIONAL ELECTIVE (PE)

The Professional Elective Courses (PE) are shown in different tracks/groups: The students will have options of selecting the electives from the different tracks/groups depending on the specialization one wishes to acquire.



ELECTIVE TRACK/GROUP	Professional Elective-1	Professional Elective-2	Professional Elective-3	Professional Elective-4	Professional Elective-5
Communications	An Introduction to coding theory (20EC4001)	Antennas (20EC407)	Satellite communication (20EC4013)	Wireless communication (20EC4019)	Signal Processing for mm Wave Communication for 5G and Beyond (20EC4025)
Micro Electronics	Industrial Electronics (20EC4002)	Micro Electronics (20EC4008)	Introduction to MEMS (20EC4014)	Fundamentals of Nano and Quantum Photonics (20EC4020)	High Speed Electronics (20EC4026)
Signal & Image Processing	MATLAB Programming For Numerical Computation (20EC4003)	Adaptive Signal Processing (20EC4009)	Introduction to Machine Learning (20EC4015)	Digital Image Processing (20EC4021)	Digital Speech Processing (20EC4027)
VLSI	Fundamentals of Micro and Nano Fabrication (20EC4004)	Mixed Signal Design (20EC4010)	RF Integrated Circuits (20EC4016)	Low Power VLSI Design (20EC4022)	FPGA Architectures (20EC4028)
Embedded System	Semiconductor Memories (20EC4005)	Real Time Operating Systems (20EC4011)	Introduction to Internet of things (20EC4017)	Advanced Embedded Logic design (20EC4023)	Embedded System Design with ARM (20EC4029)
Automation	Programmable Logic Controllers (20EC4006)	Electronic Measurements & Instrumentation (20EC4012)	Biomedical Instrumentation (20EC4018)	Virtual Instrumentation (20EC4024)	Process Control & Instrumentation (20EC4030)
MOOCS	MOOCS-1 (20EC4031)	MOOCS-2 (20EC4032)	MOOCS-3 (20EC4033)	MOOCS-4 (20EC4034)	MOOCS-5 (20EC4035)

HONORS



S. NO.	COURSE NAME	COURSE CODE	CREDITS
POOL 1			
1	CMOS IC Design	20ECH001	4
2	CAD for VLSI	20ECH002	4
3	VLSI Testing	20ECH003	4
4	ASIC Design	20ECH004	4
POOL 2			
1	Spread Spectrum Communications	20ECH005	4
2	Modern Digital Communication Techniques	20ECH006	4
3	Cellular and Mobile Communications	20ECH007	4
4	Radar Systems	20ECH008	4
POOL 3			
1	Multimedia Compression Techniques	20ECH009	4
2	Digital Video Processing	20ECH010	4
3	Advanced Digital Signal Processing	20ECH011	4
4	DSP Algorithms and Architectures	20ECH012	4
POOL 4			
1	Advanced Microcontroller	20ECH013	4
2	ARM Based Development	20ECH014	4
3	Embedded Computing	20ECH015	4
4	Embedded Software Testing	20ECH016	4

MINORS

S. NO	SUBJECT	COURSE CODE	CREDITS
1	Network Analysis	20ECM001	4
2	Electronic Devices Circuits	20ECM002	4
3	Signals and Systems	20ECM003	4
4	Information Theory and Coding	20ECM004	4
5	Electronic Circuit Analysis	20ECM005	4
6	Microprocessors	20ECM006	4
7	Integrated Circuits	20ECM007	4
8	Digital Signal Processing	20ECM008	4

HUMANITIES AND SOCIAL SCIENCES (HS)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
I	English	20EN1001	2
	English Language Lab	20EN1501	1.5
II	Oral Communication Skills Lab	20EN1502	1
VII	Humanities and Social Science Elective	20HS5008	2
TOTAL			6.5

BASIC SCIENCES (BS)



SEMESTER	SUBJECT	COURSE CODE	CREDITS
I	Applied Physics	20PH1001	3
	Algebra and Calculus	20MA1001	4
	Applied Physics Lab	20PH1501	1.5
II	Vector Calculus and Transforms	20MA1004	4
	Chemistry	20CH1001	3
	Chemistry Lab	20CH1501	1.5
III	Complex Analysis and Numerical Methods	20MA1005	3
TOTAL			20

ENGINEERING SCIENCES (ES)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
I	Problem Solving and Programming	20ES1001	3
	Engineering and IT Workshop	20ES1505	2
	Problem Solving and Programming Lab	20ES1506	1.5
	Electronics and Communication Engineering Workshop	20ES1502	1
II	Basic Electrical Engineering	20ES1004	3
	Introduction to Python Programming	20ES1007	2
	Introduction to Python Programming Lab	20ES1510	1
	Engineering Graphics lab	20ES1504	3
	Basic Electrical Engineering Lab	20ES1509	1
III	Data Structures	20ES1011	3
	Electronic Devices and Circuits	20ES1013	3
	Electronic Devices and Circuits Lab	20ES1516	1.5
TOTAL			25



PROFESSIONAL CORE (PC)

SEMESTER	COURSE CODE	SUBJECT	CREDITS
III	20EC2001	Digital Logic Design	3
	20EC2002	Network Theory	3
	20EC2501	Digital Logic Design Lab	1.5
	20EC2502	Network Theory Lab (2+2)	9
IV	20EC2007	Analog Electronics	3
	20EC2003	Electromagnetic Theory and Transmission Lines	3
	20EC2004	Control System	2
	20EC2005	Probability and Random Processes	3
	20EC2006	Signals and Systems	3
	20EC2503	Analog Electronics Lab	1
	20EC2504	MATLAB and Simulink Lab (5+2)	16.5
	20EC2008	Analog and Digital Communications	3
V	20EC2009	Linear IC Applications	3
	20EC2010	Microprocessors and Microcontrollers	3
	20EC2505	Analog and Digital Communications Lab	1.5
	20EC2506	Microprocessors and Microcontrollers Lab (3+2)	12
	20EC2011	Digital Design using HDL	3
VI	20EC2012	Digital Signal Processing	3
	20EC2507	Digital Signal Processing Lab	1.5
	20EC2508	Integrated Circuits Lab	1.5
	20EC2509	VLSI Design Lab (3+3)	10.5
	20EC2013	VLSI Design	3
VII	20EC2014	Microwave and Optical Communications	3
	20EC2510	Electronic Design Workshop	1.5
	20EC2511	Microwave and Optical Communications Lab (1+2)	8.5
	TOTAL		

PROFESSIONAL ELECTIVES (PE)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Professional Elective I	20EC4001-06	3
VI Sem	Professional Elective II	20EC4007-12	3
	Professional Elective III	20EC4013-18	3
VII Sem	Professional Elective IV	20EC4019-24	3
	Professional Elective V	20EC4025-30	3
TOTAL			15

OPEN ELECTIVES (OE)

SEMESTER	SUBJECT	CREDITS
IVSem	Open Elective I	3
V Sem	Open Elective II	3
VI Sem	Open Elective III	3
VII Sem	Open Elective IV	3
TOTAL		12



SKILL ORIENTED COURSE (SC)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
III Sem	Career Competency Development I	20CD6001	1
	Value Added Course/Certificate Course I	20CC6001	1
IV Sem	Career Competency Development II	20CD6002	1
	Value Added Course/Certificate Course II	20CC6002	1
V Sem	Career Competency Development III	20CD6003	1
	Value Added Course/Certificate Course III	20CC6003	1
VI Sem	Career Competency Development IV	20CD6004	1
	Value Added Course/Certificate Course IV	20CC6004	1
VII Sem	Career Competency Development V	20CD6005	1
	Skill Development Training	20CC6501	1
TOTAL			10

PROJECT (PR)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Internship I/on job training/Com Ser Project	20EC7501	1.5
VII Sem	Internship II/on job training/Com Ser Project	20EC7502	1.5
VIII Sem	Project work, seminar and internship	20EC7503	12
TOTAL			15

S. NO	CAT	CREDITS PER SEMESTER								CREDITS	AICTE	
		I	II	III	IV	V	VI	VII	VIII			
1	HS	3.5	1					2		6.5	12	
2	BS	8.5	8.5	3						20	25	
3	ES	7.5	10	7.5						25	24	
4	PC			9	16.5	12	10.5	8.5		56.5	48	
5	OE				3	3	3	3		12	18	
6	PE					3	6	6		15	18	
7	PR					1.5		1.5	12	15	15	
8	SC			2	2	2	2	2		10	--	
	MC	No Credits										NC
	TOTAL	19.5	19.5	21.5	21.5	21.5	21.5	23	12	160	160	



NARAYANA ENGINEERING COLLEGE:: GUDUR								
20MA1001	ALGEBRA & CALCULUS (CSE, ECE, EEE, CE, ME)						R-2020	
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	1	0	64	4	40	60	100
Pre-requisite: Intermediate Mathematics								
Course Objectives:								
<ol style="list-style-type: none"> 1. To familiarize the students with the theory of matrices and quadratic forms 2. To analyze first order ordinary differential equations. 3. To enlighten the learners in the concepts of higher order differential equation and its applications 4. To explain the series expansions using mean value theorems and the concepts of multivariable differential calculus. 5. To summarize the procedure to solve the partial differential equations. 6. To explain the student with mathematical tools needed in evaluating multiple integrals and its applications. 								
Course Outcomes: After successful completion of the course, the student will be able to							Blooms taxonomy Level	
CO 1	Solve the system of Linear Equations (BL-3)							
CO 2	Solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases. (BL-3)							
CO 3	Obtain the complete solution of a higher order differential equations (BL-2)							
CO 4	Make use of the Taylor's and Maclaurin's Series and Maxima, Minima for the given function (BL-3)							
CO 5	Apply a range of techniques for solutions of first order Linear and non linear Partial Differential Equations (PDE) (BL-3)							
CO 6	Apply the techniques of Multiple integrals for the Area of the region bounded by curves and volume (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2												
CO2	3	3	1											
CO3	3	3	1											
CO4	3	2												
CO5	3	3	1											
CO6	3	2												

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	MATRICES	14 h
Introduction to matrices, Definition of Rank ,Definition of Echelon form , Problems, Solving System of Non-Homogeneous equations- Definition, Conditions for Consistency, Problems, Solving System of Homogeneous equations- Definition, Problems, Eigen values & Eigen Vectors- Definition, Problems ,properties of Eigen values & Eigen Vectors(Without proof), Cayley – Hamilton Theorem - Statement(Without proof),finding inverse and power of a matrix by Cayley-Hamilton Theorem, Diagonalization of a Matrix-Definition, similarity of a matrix ,modal matrix, spectral matrix,powers of a		

matrix, problems on Diagonalization of a matrix, Quadratic Forms- Definition, Finding Matrix from Q.F, Index, signature, rank and nature of the quadratic forms, Reduction of Q.F. into a canonical form by linear transformation, Reduction of Q.F. into a canonical form by orthogonal transformation.

At the end of the Module 1, students will be able to:

1. Solve the system of homogenous and non-homogenous linear equations.(BL-3)
2. Obtain the Eigen values and Eigen vectors of a matrix.(BL-2)
3. Identify special properties of matrix and for using this information to study the nature of the linear equations. (BL-3)
4. Find the inverse and powers of a square matrix.(BL-1)
5. Obtain the diagonalization form of the matrix.(BL-2)
6. Apply the techniques of matrices in various engineering problems. (BL-3)

MODULE -2	FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	9h
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Exact Differential equation - Definition, condition for exactness, problems, Non - Exact Differential equations- Integrating factor, Method1: Integrating factor by inspection, problems, Method2: Finding Integrating factor, problems, Method3: Finding Integrating factor, problems, Method4: Finding Integrating factor, problems, Method5: Finding Integrating factor, problems, Linear differential Equation- Definition, Working rule to find general solution, problems, Bernoulli's differential Equation- Definition, Working rule to find general solution, problems, Applications of Differential equation of First order: Newton's law of Cooling-Explanation of the concept, problems, Law of natural growth and Decay- Explanation of the concept, problems and Simple Electric Circuits-Explanation of the concept, problems.

At the end of the Module 2, students will be able to:

1. Identify the first order ordinary differential equations. (BL-3)
2. Solve the first order ordinary differential equations. (BL-3)
3. Apply the techniques of first order ordinary differential equations in Newton's law of cooling, Natural growth & Decay problems. (BL-3)
4. Make Use of the first order ordinary differential equation techniques in simple electric circuits.(BL-3)

MODULE-3	HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS	10h
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Non-Homogenous Linear Differential equation of second and higher order with constant coefficients- Definition, complete solution, operator D, rules for finding Complimentary function, problems, inverse operator, General method for finding Particular Integral.

Non-homogeneous Linear Differential Equations of Second & Higher order with Constant coefficients with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, Polynomial in X, $e^{ax}v(x)$, X.V(x)-Explanation of the concept & problems, Method of variation of parameters- Explanation of the concept & problems, Euler-Cauchy equation- Definition, problems, Legendre's Linear equation- Definition, problems. Applications to Higher order Differential Equations - L-C-R circuits, problems.

At the end of the Module 3, students will be able to:

1. Identify the higher order ordinary differential equations. (BL-3)
2. Solve the linear differential equations with constant coefficients by appropriate methods. (BL-3)
3. Solve the linear differential equations with variable coefficients by appropriate methods.(BL-3)
4. Make Use of the higher order ordinary differential equations techniques in electrical circuits. and in various engineering problems. (BL-3)

MODULE-4	MEAN VALUE THEOREMS & MULTIVARIABLE CALCULUS	9h
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Taylor's and Maclaurin's theorems with remainders-Statements (without proof), problems on Taylor's series, problems on Maclaurin's series, Jacobean-Definition, Properties, problems, Functional dependence-Definition, problems, Maxima & Minima of function of two variables - Rules, Maxima & Minima of function of two variables without constraint- problems, Maxima & Minima of function of two variables with constraint- problems, Lagrange's Method of Undetermined multipliers, problems.

At the end of the Module 4, students will be able to:

1. Demonstrate the given function as a series of Taylor's and maclurin's with remainders.(BL-2)
2. Illustrate series expansions of functions using mean value theorems. (BL-2)
3. Apply Jacobean concept to deal with problems in change of variables.(BL-3)
4. Obtain the maxima and minimum values of the function for two variables.(BL-2)
5. Apply the mean value theorems to check the continuity of the function in the given interval. (BL-3)

MODULE-5	PARTIAL DIFFERENTIAL EQUATIONS	11h
Definition ,Formation of PDE by the Method of Elimination of arbitrary constants, problems ,Method of Elimination of arbitrary functions, problems, Method of Separation of Variables-Explanation of the concept& problems, First order linear partial differential equations-Definition, Solutions of first order linear PDE-Working rule of Lagrange's Method, problems ,First order non-linear partial differential equations- Definition, Solutions of first order non-linear partial differential equations-Standard form-I, problems , Standard form-II, problems ,Standard form-III, problems, Standard form-IV, problems.		
At the end of the Module 5, students will be able to: <ol style="list-style-type: none"> 1. Identify the basic properties of partial differential equations. (BL-3) 2. Outline partial differential equations. (BL-2) 3. Solve the applications of PDE by using the method of separation of variables (BL-3) 4. Apply the PDE techniques in various engineering fields. (BL-3) 		
MODULE-6	MULTIPLE INTEGRALS	11h
Double Integrals- Introduction, Evaluation in Cartesian coordinates, problems, Evaluation in Polar coordinates, change of variables – Problems on Cartesian to Polar, Change of Order of Integration-Problems , Area enclosed by plane curves - Problems, Triple integrals- Introduction, Evaluation of Triple Integrals, Volume by Triple Integrals – Problems, Change of variables between Cartesian, cylindrical and spherical polar coordinates- Problems.		
At the end of the Module 6, students will be able to: <ol style="list-style-type: none"> 1. Obtain double integrals in Cartesian and polar co-ordinates. (BTL-2) 2. Obtain the area bounded by a region using double integration techniques.(BTL-2) 3. Solve triple integrals.(BTL-3) 4. Obtain volumes by using triple integrals.(BTL-2) 4. Make Use of multiple integral techniques in engineering problems.(BTL-3) 		
Total hours:		64 hours
Content beyond syllabus: <ol style="list-style-type: none"> 1. Orthogonal Trajectories. 2. Deflection of Beams. 3. Simultaneous Linear equations with constant coefficients 4. Taylor's series for function of two variables. 5. HomogeneousLinear Partial differential equations with constant coefficients. 6. Calculation of mass, centreof gravity, moment of inertia 		

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Matrices	CO1	https://youtu.be/P2pL5VThrzQ
2	First Order Ordinary Differential Equations	CO2	https://youtu.be/P7gVp333B6M

3	Higher Order Ordinary Differential Equations	CO3	https://youtu.be/btOCUmJkrrg
4	Mean value theorems & Multivariable Calculus:	CO4	https://youtu.be/bJPuy0QZ-tE https://youtu.be/0apMXhWG_W8 https://youtu.be/aqfSOOiO2kI
5	Partial Differential Equations	CO5	https://youtu.be/kZ7Oa7iMiCs
6	Multiple Integrals	CO6	https://youtu.be/mIeeVrv447s

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
3. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Reference Book(s):

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education
4. H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.

NARAYANA ENGINEERING COLLEGE :: GUDUR														
20PH1001	APPLIED PHYSICS							R2020						
Semester	Hours / Week			Total hrs	Credit	Max Marks								
	L	T	P			C	CIE	SEE	TOTAL					
I	3	0	0	48	3	40	60	100						
Pre-requisite: Fundamental concepts of Physics														
Course Objectives:														
<ol style="list-style-type: none"> To identify the importance of the optical phenomenon i.e. interference and diffraction related to its Engineering applications To enable the students in understanding the importance of quantum physics To learn the dynamics of free electrons in metals by applying Free electron theories on metals. To explain and provide the knowledge about semiconductors To teach the concepts related to superconductivity & nanomaterials which leads to their fascinating applications. To impart knowledge in basic concepts of LASERs along with its Engineering applications. 														
Course Outcomes: After successful completion of the course, the student will be able to:														
CO 1	Explain optical phenomenon i.e. interference, diffraction using Huygen's wave theory.													
CO 2	Comprehend and explain the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale.													
CO 3	Comprehend Free electron theories on metals and apply them to learn the dynamics of free electrons in metals													
CO 4	Compute carrier concentration in semiconductors and to understand carrier transport mechanism in semiconductors													
CO 5	Understand the concepts of superconductors and nanomaterials to familiarize their applications in relevant fields.													
CO 6	Realize importance of LASERs in Engineering and Medical applications.													
CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1									2		
CO2	3	2										2		
CO3	2	2										1		
CO4	3	2										2		
CO5	3	2				1						2		
CO6	3	2				1						2		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	WAVE OPTICS	9h
Interference-Principle of Superposition, Interference of light, Conditions for sustained Interference ,derivation of conditions for constructive and destructive interference of reflected light from a thin film, Newton's Rings-experimental arrangement, Determination of Wavelength; Engineering applications of Interference Diffraction-distinction between interference and diffraction, differences between Fresnel & Fraunhofer diffractions, Fraunhofer Diffraction at single slit(derivation, energy distribution curve) , Fraunhofer Diffraction at a Double slit (derivation, energy distribution curve), Theory of Diffraction Grating -Determination of Wavelength; Engineering applications of diffraction		

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. explain the need of coherent sources and the conditions for sustained interference (BL2) 2. describe the theory of interference of reflected light from a thin film (BL2) 3. explain the theory of Fraunhofer Diffraction of light at single and multiple slits (BL2) 4. identify engineering applications of interference and diffraction (BL3) 5. analyze the differences between interference and diffraction (BL4) 		
MODULE -2	INTRODUCTION TO QUANTUM MECHANICS	8h
Matter waves -de-Broglie hypothesis - properties, G.P.Thomson experiment, Phase and group velocities—Expression for group velocity; Heisenberg's uncertainty principle; Schrodinger's time dependent and independent wave equations – Physical significance of wave function-important characteristics of wave function, free particle energy, wave function, momentum; operators and expectation values, Eigen values and Eigen functions of a particle confined to one dimensional infinite square well (potential well).		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. understand the concept of matter waves (BL2) 2. Recognize the difference between phase velocity and group velocity (BL2). 3. understand Physical significance of wave function (BL2) 4. Identify the importance of Schrodinger's wave equation in describing the motion of Elementary particles (BL3). 		
MODULE-3	FREE ELECTRON THEORY OF METALS	8 h
Classical free electron theory-assumptions, expression for electrical conductivity, merits and demerits; Quantum free electron theory of metals-expression for electrical conductivity; Fermi-Dirac distribution, Mathiessen rule, causes of electrical resistance in metals, Bloch's theorem (Qualitative), Kronig - Penny Model (Qualitative), effective mass and Brillouin zones, Classification of solids into conductors, semiconductors and insulators based on energy band gap.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain classical, Quantum free electron theory of metals (BL2). 2. Apply these theories to explain electrical conductivity in metals (BL3) 3. Explain formation of energy bands in solids (BL2). 4. Understand the band structure of a solid and Classify materials as metals, insulators, or semiconductors, and sketch a schematic band diagram for each one (BL2). 		
MODULE-4	INTRODUCTION TO SEMICONDUCTORS	8 h
Origin of energy bands, Intrinsic semiconductors - density of charge carriers (derivation), Fermi energy, Electrical conductivity; extrinsic semiconductors - P-type & N-type, Density of charge carriers, Dependence of Fermi energy on carrier concentration and temperature; Direct and Indirect band gap semiconductors, Hall effect- Hall coefficient (derivation), Applications of Hall effect; Drift and Diffusion currents, Einstein coefficients, Continuity equation (derivation), Applications of Semiconductors.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Outline the properties of n-type and p-type semiconductors (BL2). 2. Interpret the direct and indirect band gap semiconductors (BL2). 3. Identify the type of semiconductor using Hall effect (BL3). 4. Identify applications of semiconductors in electronic devices (BL3) 		
MODULE-5	SUPERCONDUCTORS AND NANOMATERIALS	8 h
Superconductors- Properties, Meissner's effect, BCS Theory, Josephson effect (AC & DC), Types of Superconductors, Applications of superconductors. Nano materials – Significance of nanoscale, Properties of nanomaterials: Physical, mechanical, Magnetic, Optical; Synthesis of nanomaterials: Top-down-Ball Milling, Bottom-up – Chemical vapour deposition; Applications of Nano materials.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Explain how electrical resistivity of solids changes with temperature (BL2) 		

2. Classify superconductors based on Meissner's effect (BL2) 3. Explain Meissner's effect, BCS theory & Josephson effect in superconductors (BL2) 4. Identify the nano size dependent properties of nanomaterials (BL3) 5. Illustrate the methods for the synthesis and characterization of nanomaterials (BL2) 6. Apply the basic properties of nanomaterials in various Engineering branches (BL3)			
MODULE-6	LASERS & OPTICAL FIBERS		7 h
Lasers: Spontaneous & stimulated emission of radiation, Population inversion, Pumping methods, Properties of lasers- monochromaticity, coherence, directionality, brightness, Types of lasers: Nd-YAG Laser, He-Ne Laser, Semiconductor laser; Applications. Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile-advantages of optical fibres.			
At the end of the Module 6, students will be able to: <ol style="list-style-type: none"> 1. describe Spontaneous & stimulated emission of radiation (BL2) 2. Understand the basic concepts of LASER light Sources (BL2) 3. describe the construction and working of different types of Lasers (BL2) 4. identify the applications of lasers in various fields (BL3) 			
Content beyond syllabus: Polarization of light.			
Self-Study: Contents to promote self-Learning:			
SN O	Topic	CO	Reference
1	WAVE OPTICS	CO 1	https://youtu.be/n65gZGwiZtk
2	INTRODUCTION TO QUANTUM MECHANICS	CO 2	https://youtu.be/w7Wf3Wr0guA?list=PL1955A15B7F28A7F https://youtu.be/NfkJKIoExYo?list=PL1955A15B7F2827F
3	FREE ELECTRON THEORY OF METALS	CO 3	https://youtu.be/L-eOdZFt9BY https://youtu.be/G2zgAs5O7I8
4	INTRODUCTION TO SEMICONDUCTORS	CO4	https://youtu.be/BQijtvYxgIM https://youtu.be/rzxCRJcFaIw
5	SUPERCONDUCTORS AND NANOMATERIALS	CO5	https://youtu.be/GglT1RoBPzg https://youtu.be/iiT_KJJ1Uhs
6	LASERS	CO6	https://youtu.be/eoOM0Gx6GJc https://youtu.be/RyY4PEpV2RQ
Total hours:			48 hours
Text Book(s):			
1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy "A Text book of Engineering Physics"- S. Chand Publications, 11th Edition 2019. 2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012. 3. S.O. Pillai, "Solid State Physics", 8th edition, New Age International Publishers, 2018.			

Reference Book(s):

1. Shatendra Sharma, Jyotsna Sharma, “ Engineering Physics”, Pearson Education, 2018
2. N. Subrahmanyam, Brij Lal, *A Textbook of Optics*, S. Chand, New Delhi, 2015
3. Kittel, C. —Introduction to Solid State Physics||. Wiley, 2005.
4. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
5. Ajoy Ghatak, *Optics*, 5th Edition, McGraw Hill, 2012
6. O. Svelto, “Principles of Lasers”, Springer Science & Business Media, 2010.
7. William T. Silfvast, “Laser Fundamentals” 2nd edition, Cambridge University Press, 2004.
8. T. Pradeep, “A Text Book of Nanoscience and Nanotechnology”, Tata Mc Graw Hill, 2003

Online Resources:

1. <http://www.peaceone.net/basic/Feynman/>
2. <http://physicsdatabase.com/free-physics-books/>
3. <http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf>
4. <http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html>

Web Resources:

1. <http://link.springer.com/book>
2. <http://www.thphys.physics.ox.ac.uk>
3. <http://www.sciencedirect.com/science>
4. <http://www.e-booksdirectory.com>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1001	PROBLEM SOLVING AND PROGRAMMING							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

Pre-requisite: Mathematics Knowledge, Analytical and Logical skills

Course Objectives:

1. To understand various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn the syntax and semantics of a C Programming language.
5. To learn structured programming approach for problem solving.

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

CO 1	Identify methods to solve a problem through computer programming. (BL - 3)
CO 2	Understand the use of basic elements of C language. (BL - 2)
CO 3	Understand the difference and the usage of various control statement. (BL - 2)
CO 4	Apply the modular approach for solving the problems. (BL - 3)
CO 5	Apply the Arrays and Pointers for solving problems. (BL - 3)
CO 6	Explain User-Defined Data Types and Files. (BL - 2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3											1	
CO2	1	2	1										1	
CO3	1	2	1		2								2	2
CO4	2	2	3	2	1							2	3	2
CO5	3	3	2	2								1	2	
CO6	2	2	2	2								1	2	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	FUNDAMENTALS OF COMPUTERS AND PROGRAMMING	8h
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Fundamentals of computers:History of Computers, Generations of Computer, The Computer System - The Input-Process-Output Concept, Components of Computer System, Operating System - Introduction, Objectives, Functions.

Introduction to Programming, Algorithms and Flowcharts:Programs and Programming, Programming languages, Compiler, Interpreter, Structured Programming Concept, Algorithms, Flowcharts, How to Develop a Program.

Fundamental Algorithms: Exchanging the values of Two Variables, Counting, Summation of a set of numbers, Factorial computation, Generation of the Fibonacci Sequence, Reversing the digits of an integer.

At the end of the Module 1, students will be able to:

1. Illustrate the working of a Computer. (BL - 2)
2. Solve problems using language independent notations. (BL - 3)
3. Understand the compilers and interpreters. (BL - 2)
4. Understand Structured Programming. (BL - 2)
5. Develop algorithms and flowcharts for problems.(BL - 3)

MODULE -2	BASIC ELEMENTS OF C	7 h
<p>Basics of C: Introduction, Character Set, Structure of a C Program, A Simple C Program, Variables, Data Types and Sizes, Declaration, How does The Computer Store Data in Memory, Identifiers, Keywords, Constants, Assignment, and Initialization.</p> <p>Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Conditional Operator, Comma operator, sizeof operator, Expressions, L values and R values, Expression Evaluation- Precedence and Associativity, Type Conversion.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic structure of a program in C. (BL - 2) 2. Understand tokens in C language.(BL - 2) 3. Illustrate the working of expressions.(BL - 2) 4. Understand the precedence and Associativity rules of operators. (BL - 2) 5. Understand the rules of type conversion. (BL - 2) 		
MODULE-3	DATA INPUT / OUTPUT AND CONTROL STATEMENTS	8 h
<p>Input and Output: Basic Screen and Keyboard I/O in C, Formatted Input and Output, Unformatted Input and Output Functions</p> <p>Control Statements: Selection Statements - if, Nested if, if-else, Nested if-else, else-if ladder, switch Looping Statements - while, do-while, for, Nested loops, Unconditional Statements - goto, break, continue, return.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the Formatted and Unformatted I/O functions. (BL - 2) 2. Understand Selection Statements. (BL - 2) 3. Understand Looping Statements. (BL - 2) 4. Explain Unconditional Statements. (BL - 2) 		
MODULE-4	FUNCTIONS AND PROGRAM STRUCTURE	8 h
<p>Functions: Introduction, Using Functions, Passing Arguments to a Function, Working with Function, Scope and Extent, Recursion, The C Preprocessor.</p> <p>Program Structure: Storage classes, Automatic variables, External variables, Static variables, Register variables, Multifile programs.</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic concept of functions. (BL - 2) 2. Understand concept of Recursion and Preprocessor. (BL - 2) 3. Explain storage specifiers. (BL - 2) 		
MODULE-5	ARRAYS AND POINTERS	9 h
<p>Arrays and Strings: Introduction, One-Dimensional Array, Multidimensional Arrays, Passing Arrays to Function, Strings - Declaration, Initialization, Printing Strings, String Input, Character Manipulation, String Manipulation, Arrays of Strings.</p> <p>Pointers: Fundamentals, Pointer Declarations, Operations on pointers, Passing Pointers to a Function, Pointers and Arrays, Arrays of Pointers, Pointer to Pointer, Pointer to Functions, Command line arguments, Dynamic Memory Management.</p>		
<p>At the end of the Module 5, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concept of Arrays. (BL - 2) 2. Understand the concept of pointers. (BL - 2) 3. Explain Dynamic Memory Management. (BL - 2) 		
MODULE-6	USER-DEFINED DATA TYPES AND FILES	8 h
<p>Structures and Unions: Basics of Structures, Nesting of Structures, Arrays of Structures, Structures and Pointers, Structures and Functions, Self-Referential Structures, Unions, Bit-fields, Enumerations, typedef.</p> <p>Files: Introduction, Using Files in C, Working with Text Files, Random Accesses to Files of Records.</p>		
<p>At the end of the Module 6, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain user defined data types. (BL - 2) 2. Understand the concept of Self-Referential Structures. (BL - 2) 3. Understand the working of files. (BL - 2) 		
Total hours:		48 Hours

Content Beyond Syllabus:

1. Analysis of Algorithms
2. Binary Files
3. Variable Length Argument Lists

Self-Study:

Contents to promote self-Learning:

S. No	Module	Reference
1	Fundamentals of Computers and Programming	https://nptel.ac.in/courses/106/106/106106127/ [Lec1] https://nptel.ac.in/courses/106/105/106105214/ [Week 1 - Lec 1 To 2] https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec 1 To 4]
2	Basic Elements of C	https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 2 - Lecture 7 To 10] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec 11 To 14] https://nptel.ac.in/courses/106/106/106106127/ [Lec2] https://nptel.ac.in/courses/106/106/106106127/ [Lec3] https://nptel.ac.in/courses/106/106/106106127/ [Lec4]
3	Data Input / Output and Control Statements	https://nptel.ac.in/courses/106/106/106106127/ [Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec15] https://nptel.ac.in/courses/106/105/106105171/ Week 4 - Lec 16 To 20] [Week 5 - Lec 21 To 25] https://nptel.ac.in/courses/106/106/106106127/ [Lec 6 &7]
4	Functions and Program Structure	https://nptel.ac.in/courses/106/105/106105171/ [Week 7 - Lec35] [Week 8 - Lecture 36 To 40] https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 53 To 54] https://nptel.ac.in/courses/106/106/106106127/ [Lec 20 To 27]
5	Arrays and Pointers	https://nptel.ac.in/courses/106/105/106105171/ [Week 6 - Lec 26 To 30][Week 7 - Lec 32 To 34,48] [Week 12 - Lec 58, 59, 61] https://nptel.ac.in/courses/106/106/106106127/ [Lec 9 To 19]
6	User-Defined Data Types and Files	https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 55, 56, 57, 60] https://nptel.ac.in/courses/106/106/106106127/ [Lec 36, 37, 38] https://nptel.ac.in/courses/106/106/106106127/ [Lec60]

Text Book(s):

1. Pradip Dey, and Manas Ghosh, “Programming in C”, 2018, Oxford University Press.
2. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Reference Books :

1. Brian W. Kernighan, and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Pearson.
2. Ajay Mittal, Programming in C: A Practical Approach , 3/e, Pearson Publication
3. SCHILDT and HERBERT, C: The Complete Reference, 4th Edition, McGraw Hill, 2020
4. SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., Problem Solving with C, 2nd Edition, PHI Learning, 2018
5. Paul Deitel, Deitel & Harvey Deitel, C How to Program, 6th Edition, Pearson Education
6. Jeri R. Hanly, Elliot B. Koffman, Ashok Kamthane and A. Ananda Rao, Programming in C and Data Structures, 1st Edition, Pearson Education, 2010.
7. H. Cheng, C for Engineers and Scientists, Mc.Graw-Hill International Edition Education / PHI, 2009
8. Yashavant P. Kanetkar, Let us C, 16th Edition, BBP Publications, Delhi, 2017.
9. R.G. Dromey, “How to Solve it by Computer”. Pearson, 2014.
10. Anita Goel, Computer Fundamentals, Pearson Publication, 2010.

Online Resources / Web Resources:

1. <https://nptel.ac.in/courses/106/105/106105171/>
2. <https://nptel.ac.in/courses/106/106/106106127/>
3. https://www.youtube.com/playlist?list=PLVIOHNRLfIP8IGz6OXwIV_lgHgc72aXlh
4. <https://www.youtube.com/watch?v=8PopR3x-VMY>
5. <https://www.youtube.com/watch?v=vI794HKeXug>
6. <https://books.goalkicker.com/CBook/>
7. <https://www.tutorialspoint.com/cprogramming/index.htm>
8. <https://www.programiz.com/c-programming>
9. <https://www.javatpoint.com/c-programming-language-tutorial>
10. <https://www.edureka.co/blog/c-programming-tutorial/>
11. <https://data-flair.training/blogs/c-tutorial/>
12. <https://www.programmingsimplified.com/c-program-examples>
13. <https://www.w3schools.in/category/c-tutorial/>
14. C Programming Notes for Professionals book : <https://books.goalkicker.com/CBook/>

NARAYANA ENGINEERING COLLEGE :: GUDUR								
20EN1001	ENGLISH							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
I	2	0	0	32	2	40	60	100
Pre-requisite: Knowledge of fundamentals of English Language & Grammar								
Course Objectives:								
<ol style="list-style-type: none"> To enhance the linguistic and communicative competence. To improve the Language proficiency of students in English with an emphasis on Vocabulary, Reading and Writingskills. To provide knowledge of grammatical structures & rules and encourage their appropriate use. To expose the students to Reading skills and apply the skill & strategies of a successful reader To acquaint the students with effective strategies of paragraphs, note making, text editing, review writing and formal correspondence such as letter writing, e mail, and memos. To aid the students acquire appropriate and adequate knowledge on writing Technical Reports. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Acquire in depth knowledge on formulating appropriate sentences with grammatical accuracy and vocabulary building. (B.L:2)							
CO 2	Understand the factors that influence in use of grammar and learn to use sentences unambiguously. (B.L:2)							
CO 3	Impart effective strategies for professional written communication using devices of coherence & cohesion with adequate support & detail. (B.L:3)							
CO 4	Provide knowledge of use of phrases & clauses and improve effective writing Note making & Paraphrasing. (B.L:2)							
CO5	Understanding the grammar rules for synthesis of sentences and use prewriting strategies to plan to write dialogues, reviews and edit the text effectively.(B.L:2)							
CO6	Master the skills and sub skills of reading and use strategies for reading effectively and provide knowledge on the structure and format of technicalwriting. (B.L:3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									2		2		
CO2	1									2		2		
CO3	1									3		2		
CO4	1									2		3		
CO5	1									3		3		
CO6	1									3		3		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
Module – I	GRAMMAR& VOCABULARY BUILDING	6h
<p>Grammar :Parts of speech: Noun (Countables&Uncountables, Singulars & Plurals, Kinds of Nouns), Pronoun, Verb, Adverb, Adjective - Kinds of Sentences & Sentence Structures – Question forms – Word order in Sentence</p> <p>Vocabulary Building : Concept of word formation – Synonyms & Antonyms – Homonyms & Homophones – Prefixes & suffixes – Commonly confused Words – One word substitutes – Idioms & Phrasal Verbs</p> <p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> 1. Acquire in depth knowledge on basic grammar concepts. 2. Understand the meaning of suffixes & Prefixes, idioms and phrasal verbs. 3. Learn meaning and usage of Vocabulary. 		
Module – II	GRAMMAR&WRITING -I	8h
<p>Grammar : Subject Verb agreement – Pronoun-antecedent agreement – Verbs: auxiliary verbs (Primary & Modal)- Tenses</p> <p>Writing : Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts - Sentence Structure – Joining the sentences - sequencing the ideas - introduction and conclusion – Punctuation.</p> <p>At the end of the Module II, students will be able to:</p> <ol style="list-style-type: none"> 1. Learn to use sentences clearly. 2. Understand the usage of grammar. 3. Learn the importance of use of Auxiliary verbs. 		
Module – III	GRAMMAR&WRITING-II	10h
<p>Grammar : Direct & Indirect Speech – Active and Passive Voice – Comparison of Adjectives – Articles – Prepositions</p> <p>Writing : Paragraph Writing - Phrases & Clauses – Conditionals - Business letters and Emails and Memos - Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order</p> <p>At the end of the Module III, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand and learn the nuance of writing business letters, e-mails, memos and effective paragraphs 2. Learn to use devices of coherence & cohesion with adequate support & detail 3. Learn the use of prepositions and active & passive voice in engineering and scientific contexts. 		
Module – IV	GRAMMAR&WRITING-III	10h
<p>Grammar :Phrasal Verb – Cause and effect – Verb noun Collocations & adjective-noun collocations – correcting common errors in grammar and usage - Misplaced modifiers, idiomatic expressions</p> <p>Writing :Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing - Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures.</p> <p>At the end of the Module IV, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the usage of phrases and clauses in sentences 2. Learn grammatical rules to encourage their appropriate use in writing 3. Learn to write effective note making and paraphrase 		
Module – V	GRAMMAR&WRITING-IV	8h
<p>Grammar :Question formation (Wh- questions, Yes or No questions, Tag questions)-If Clauses— Simple, Compound, Complex Sentences - Correcting common errors in grammar and usage</p> <p>Writing :Editing short texts - Dialogue writing - Writing Definitions (short and long) – compare and contrast paragraphs- Writing of Reviews : Book / Play / Movie - focus on appropriate vocabulary and structure - language items like special vocabulary and idioms used</p> <p>At the end of the Module V, students will be able to:</p> <ol style="list-style-type: none"> 1. Acquire the knowledge of applying the grammatical rules for synthesis of sentences 		

2. Learn to write dialogues for various contexts
3. Learn to edit the text and writing reviews

Module – VI

READING SKILLS

6h

Reading Skills :Types of reading: Skimming, Scanning, Intensive & Extensive Reading - Effective Reading-Tips

Reading Comprehension

Scramble Sentences

Complete the passage using contextual clues

Identifying Main Ideas using Scanning Technique

Identifying Specific Ideas using Skimming Technique

Writing :Describing – Report Writing: definition - purpose – types – structure - formal and informal reports - stages in developing report- proposal, progress and final reports –examples

At the end of the Module VI, students will be able to:

1. Master the skills and sub skills of reading
2. Learn the structure and format of technical reports
3. Learn to write description of things, process, places and persons

Content beyond syllabus:

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vocabulary for Aptitude & Recruitment Tests Campus Jobs	CO1	https://youtu.be/uzvZa2qEuWo
2	Tips to Improve Verbal and Written Communication Skills	CO2	https://youtu.be/6Y3NY0ERBxY
3	How to write professional emails in English	CO3	https://youtu.be/3Tu1jN65slw
4	Introduction to Collocation	CO4	https://youtu.be/-ouWOp2Uh8
5	Error Spotting Questions in Campus Recruitment Tests	CO5	https://youtu.be/Rz6-qjNrZCU
6	Reading Skills: How To Skim, Scan and Read for Detail Effectively	CO6	https://youtu.be/SRHNKzXxu6o

Text Books:

1. Green, David Contemporary English Grammar –Structures and Composition, MacMillan India,2014
2. Raymond Murphy’s English Grammar with CD, Murphy, Cambridge University Press,2012
3. Michael Swan, (2017) Practical English Usage (Practical English Usage), 4th edition, UK:OxfordUniversity Press.
4. Ashraf, M Rizvi. Effective Technical Communication. Tata McGraw-Hill,2006.

Reference Books

1. English Conversation Practice –Grant Taylor, Tata McGraw Hill,2009.
2. Hewings, Martin. Cambridge Academic English (B2). CUP,2012
3. Meenakshi Raman and Sangeeta Sharma, Professional Communication, Second Edition, Oxford University Press, India,2017
4. Michael McCarthy, Felicity O'Dell, (2015) English Vocabulary in Use Advanced(South Asian Edition), UK: Cambridge UniversityPress
5. Spoken English, R.K. Bansal & JB Harrison, Orient Longman,2013, 4Thedition.

Web References:

1. *Grammar/Listening/Writing1-language.com*
2. <http://www.5minuteenglish.com/>
3. <https://www.englishpractice.com/>

Grammar/Vocabulary

1. *English Language LearningOnline*
2. <http://www.bbc.co.uk/learningenglish/>
3. <http://www.better-english.com/>
4. <http://www.nonstopenglish.com/>
5. <https://www.vocabulary.com/>
6. *BBC Vocabulary Games*
7. *Free Rice VocabularyGame*

Reading

1. <https://www.usingenglish.com/comprehension/>
2. <https://www.englishclub.com/reading/short-stories.htm>
3. <https://www.english-online.at/>
4. <https://learningenglish.voanews.com/z/3613>
5. <http://www.englishmedialab.com/listening.html>

Speaking

1. <https://www.talkenglish.com/>
2. *BBC Learning English – Pronunciation tips*
3. *Merriam-Webster – Perfect pronunciationExercises*

All Skills

1. <https://www.englishclub.com/>
2. <http://www.world-english.org/>

Online Dictionaries

1. *Cambridge dictionary online* :<https://dictionary.cambridge.org/>
2. *MacMillan dictionary* :<https://www.macmillandictionary.com/>
3. *Oxford learner's dictionaries* :<https://www.oxfordlearnersdictionaries.com/>

NARAYANA ENGINEERING COLLEGE:GUDUR														
20PH1501	APPLIED PHYSICS LAB												R2020	
Semester	Hours / Week			Total hrs	Credit C	Max Marks								
	L	T	P			CIE	SEE	TOTAL						
I	0	0	3	36	1.5	40	60	100						
Pre-requisite: Nil														
Course Objectives:														
1. To provide student to learn about some important experimental techniques in physics with knowledge in theoretical aspects so that they can excel in that particular field. To prepare students for performing requirement analysis and design of variety of applications.														
2. To enable the students to understand the concepts of interference and diffraction and their applications.														
3. To educate students to recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies														
4. To make the students to understand the important parameters of optical fibres and metals														
Course Outcomes: After successful completion of the course, the student will be able to:														
CO 1	learn important concepts of physics through involvement in the experiments by applying theoretical knowledge.													
CO 2	understand the concepts of interference and diffraction and their applications.													
CO 3	recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies													
CO 4	understand the important parameters of optical fibres and metals													
CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1										2		
CO2	2	1				1						2		
CO3	2	1				1						2		
CO4	2	1										2		
1: Low, 2-Medium, 3- High														

COURSE CONTENT														CO
Task -1: Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.														
The objective :To determine a) sign of the charge carriers, b) charge carrier concentration, c) mobility of the charge carriers of a given semiconductor														CO 1
Task - 2: To determine the resistivity of semiconductor by Four probe method														
Objective:To determine the resistvity of semiconductor by Four probe method														CO 1
Task -3: Determine the energy gap of a given semiconductor diode.														
Objective:To plot characteristics between reverse saturation current and $10^3 / T$ and find out the approximate value of Energy Band Gap in PN junction diode														CO 1
TASK -4: Measurement of radius of curvature of a lens by Newton's rings method.														
Objective:To determine the wavelength of sodium light by Newton's Ring method The key idea behind Newtons ring experiment is the thin film formation between a plane-convex lens and a glass plate. Due to this thin film of air a path difference occurs in the waves which reflect from the lower surface of the lens and the top surface of the glass plate. As a result of it, they superimpose and develop the interference pattern.														CO 2
TASK -5: Determine the thickness of the wire using wedge shape method														

Objective: To calculate the thickness of a thin wire by forming interference fringes using an air wedge arrangement. The key idea behind this experiment is the formation of thin wedge shaped film between two plane glass plates. Due to this thin film of air, a path difference occurs between waves reflected from top and bottom surface of the film. On superimposition of these waves an interference pattern containing a number of straight line fringes will be produced	CO 2
TASK-6: Determination of wavelength by plane diffraction grating normal incidence method	
Objectives: 1. To understand the types of diffraction 2. To familiarize with the principle of diffraction in plane transmission grating 3. To know the procedure for standardization of the grating 4. To determine the wavelengths of prominent spectral lines of mercury spectrum. An arrangement, which is equivalent in its action to a large number of parallel slits of same width separated by equal opaque spaces is called diffraction grating. It is constructed by ruling fine equidistant parallel lines on an optically plane glass plate with the help of a sharp diamond point.	CO 2
TASK -7: Dispersive power of a diffraction grating	
Objective: To determine Dispersive power of a diffraction grating When white light passes through a grating, different wavelengths undergo different angles of diffraction. Hence white light split up into different colours and diffraction spectra of different orders will be produced. The angular dispersion or dispersive power of a grating is defined as the rate of change of angle of diffraction with the change of wavelength in a particular order of the spectrum.	CO 2
TASK -8: Determination of wavelength of LASER light using diffraction grating	
Objectives :1. To determine the concept of diffraction 2. To determine the wavelength of the given Laser source.	CO 3
TASK -9: Laser: Diffraction at a single slit	
Objective: Determination of width of a given single slit using laser diffraction method Laser beam has high monochromaticity, coherence and directionality. Hence it forms a clear diffraction pattern and we can measure width of a single slit accurately.	CO 3
TASK -10 Laser: Diffraction at a double slit	
Objective: Determination of width of a given double slit using laser diffraction method. With this experiment we can demonstrate diffraction nature of lasers and measure width of a double slit accurately.	CO 3
Additional Experiments:	
TASK -11 To determine the numerical aperture and acceptance angle of a given optical fibre	
Objective: To determine the numerical aperture and acceptance angle of a given optical fiber. In optical fibres light travel by multiple total internal reflections. Numerical aperture represents light gathering power of optical fibre. Acceptance angle represents maximum limiting angle at one end of optical fibre for the light ray to travel by multiple total internal reflections through the core region of the fibre. 1. Optical fibers may be used for accurate sensing of physical parameters and fields like pressure, temperature and liquid level. 2. For military applications like fiber optic hydrophones for submarine and underwater sea application and gyroscopes for applications in ships, missiles and aircrafts.	CO 4
TASK -12: Determination of Fermi energy of a metal.	
Objective: To determine Fermi energy of a metal. Fermi energy represents highest energy level occupied by the electron at 0 K in a metal.	CO4

Virtual lab: 1) Laser beam divergence and spot size https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1 2. Michelson's Interferometer- Wavelength of laser beam https://vlab.amrita.edu/?sub=1&brch=189&sim=1106&cnt=1 3. Anderson's Bridge https://vlab.amrita.edu/?sub=1&brch=192&sim=859&cnt=1	
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Text Book(s): 1. C. L. Arora, "Practical Physics", S. Chand & Co., New Delhi, 3rd Edition, 2012. 2. Vijay Kumar, Dr. T. Radhakrishna, "Practical Physics for Engineering Students", S M Enterprises, 2nd Edition, 2014.
Reference Book(s): 1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017. 2. C.H. Bernard and C.D. Epp, John Wiley and Sons, "Laboratory Experiments in College Physics" Inc., New York, 1995. 3. Dr. Ruby Das, C.S. Robinson, Rajesh Kumar and Prasanth Kumar "A text book of Engineering Physics Practical", 1st edition, Sahu University Science Press, 2010. 4. Jayaraman, "Engineering Physics Laboratory Manual", 1st edition, Pearson Education, 2014.
Web Resources: 1. https://www.scribd.com/doc/143091652/ENGINEERING-PHYSICS-LAB . 2. https://www3.nd.edu/~wzech/LabManual_0907c.pdf . 3. https://www.morebooks.de/store/gb/book/engineering-physics-lab-manual/isbn/978-3-330-34402 .

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EN1501	ENGLISH LANGUAGE LAB							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
I	0	0	3	48	1.5	40	60	100

Pre-requisite:Basic English Grammar

Course Objectives:

1. To expose the students to develop knowledge and awareness of English phonetics be able to read and produce phonemictranscriptions
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To develop strategies appropriately to improve one's ability to listen and Use listening skills to create more effective, less confrontational, more productive professional and personal communication
4. To demonstrate his/her ability to write error free writtencommunication
5. To distinguish main ideas from specific details and make use of contextual clues to infer meanings of unfamiliar words fromcontext
6. To provide a structured methodology for participants to prepare and deliver an effective, high impact presentation that meets the objectives and bringsresults

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

CO 1	Understand how speech sounds are used to create meaning. Apply their knowledge of English phonetics and phonology to improve their own pronunciation.
CO 2	Recognize and use pitch patterns to signal complete and incomplete thought groups and Speak confidently and intelligibly within groups and before an audience.
CO 3	Discuss and respond to content of a lecture or listening passage orally and/or in writing and make inferences and predictions about spokendiscourse
CO 4	Produce coherent and unified paragraphs with adequate support and detail and can write a paragraph with a topic sentence, support, and concluding sentence
CO 5	To help the students to cultivate the habit of reading passages for competitive exams such as GRE, TOEFL, GMAT etc.
CO 6	Learn, practice and acquire the skills necessary to deliver effective, presentation with clarity and enable them to prepare resume with cover letter.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	SO 1	PSO 2
CO1	1									3		2		
CO2	1									2		3		
CO3	1									3		3		
CO4	1									2		3		
CO5	1									3		3		
CO6	1									3		3		

1: Low, 2-Medium, 3- High

COURSE CONTENT	
Module - 1	
Introduction to Phonetics : Introduction to Sounds of Speech – Vowels – Consonants - Listening with a focus on pronunciation Reading Newspaper – Highlighting Vowels and Consonants	CO1
Module – 2	
Syllabification: Word Stress, Rules of word stress Practice on Intonation and Stress	CO2
Module – 3	
Listening Skills : Types of Listening Skills Active listening and anticipating the speaker Listening for Specific & General Details Listening Comprehension	CO3
Module – 4	
Defining & Describing: Objects, Places and Events Video Speech Writing Review Writing (Books / Movies / Products..etc.,)	CO4
Module – 5	
Reading Comprehension Everyday English – Grammar, Vocabulary, LSRW Skills, Summarizing and Note making Vocabulary Building	CO5
Module – 6	
JAM Role Play Giving and Asking Directions Information Transfer	CO6

Text Book(s):

1. A Textbook of English Phonetics for Indian Students 2nd Ed
T. Balasubramanian. (Macmillan), 2012
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.

Reference Book(s): English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP

1. Rizvi, Ashraf. M., Effective Technical Communication, McGraw Hill, New Delhi. 2005
2. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi. 2011

Web References:

1. Grammar/Listening/Writing 1-language.com
2. <http://www.5minuteenglish.com/>
3. [https://www.englishpractice.com/ Grammar/Vocabulary](https://www.englishpractice.com/Grammar/Vocabulary)
4. English Language Learning Online
5. <http://www.bbc.co.uk/learningenglish/>
6. <http://www.better-english.com/>
7. <http://www.nonstopenglish.com/>
8. <https://www.vocabulary.com/>
9. BBC Vocabulary Games
10. Free Rice Vocabulary Game Reading

11. <https://www.usingenglish.com/comprehension/>
12. <https://www.englishclub.com/reading/short-stories.htm>
13. <https://www.english-online.at/> Listening
14. <https://learningenglish.voanews.com/z/3613>
15. <http://www.englishmedialab.com/listening.html> Speaking
16. <https://www.talkenglish.com/>
17. BBC Learning English – Pronunciation tips
18. Merriam-Webster – Perfect pronunciation Exercises All Skills
19. <https://www.englishclub.com/>
20. <http://www.world-english.org/>
21. <http://learnenglish.britishcouncil.org/>

Online Dictionaries

- Cambridge dictionary online :<https://dictionary.cambridge.org/>
- MacMillan dictionary :<https://www.macmillandictionary.com/>
- Oxford learner's dictionaries :<https://www.oxfordlearnersdictionaries.com/>

NARAYANA ENGINEERING COLLEGE: GUDUR														
20ES1502	ELECTRONICS AND COMMUNICATION ENGINEERING WORKSHOP						R2020							
Semester	Hours / Week			Total hrs	Credit C	Max Marks								
	L	T	P			CIE	SEE	TOTAL						
I	0	0	2	32	1	40	60	100						
Pre-requisite:														
Course Objectives:														
<ol style="list-style-type: none"> To introduce electronic components, measuring instruments and tools used in Electronic workshop. To equip with the knowledge of understanding data sheets of electronic components. To give practical experience on soldering the electronic components on a PCB To introduce EDA tools and TINA Software To provide knowledge about the different types of transmission media such as guided and unguided media. 														
Course Outcomes: After successful completion of the course, the student will be able to:														
CO 1	Identify discrete components, measuring instruments and ICs (BL-2)													
CO 2	Assembling and testing of simple electronic circuit over a PCB (BL-2)													
CO 3	Understand EDA tools and TINA Software (BL-1)													
CO 4	Understand about the different types of transmission media such as guided and unguided media. (BL-1)													
CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2			1									1	
CO2	1	1											2	
CO3	1		1										1	
CO4		2											1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1: Familiarization of commonly used tools in Electronics and Communication.	CO 1
Objective: To introduce tools used in Electronics and Communication.	
Task-2: Familiarization of Electronic Measuring Instruments	CO 1
Objective: To introduce measuring instruments used in Electronics and Communication.	
Task-3: Familiarization/Identification of electronic components	CO 1
Objective: To introduce electronic components used in Electronics.	
Task-4: Testing of electronic components	CO 2
Objective: To introduce Testing Procedure used for Electronic components	
Task-5: Study of Cathode Ray Oscilloscope (CRO)	CO 1
Objective: To study controls of CRO and measure Amplitude, Frequency and Phase of time varying signals.	
Task-6: Single Side PCB Fabrication	CO 2

Objective: To provide in-depth core knowledge in the fabrication of Printed Circuit Boards.	
Task-7: Introduction to EDA Tools	CO 3
Objective: To introduce EDA tools.	
Task-8: Assembling and Testing of simple electronic circuits on breadboards	CO 2
Objective: To give practical expose of electronic circuits on a Breadboard	
Task-9: To familiar with the optoelectronic devices	CO 2
Objective: To give practical experience on the different types of optoelectronic devices such as LED, photodiode, LDR, Photo Transistor and Photo Isolator.	
Task -10: To study about the transmission media	CO 4
Objective: To provide knowledge about the different types of transmission media such as guided and unguided media.	
Task-11: Familiarization of PA system with different microphones, loud speakers, mixer etc	CO 2
Objective: To give practical experience on Public addressing (PA) system.	
Task-12: To introduce about the TINA Software	CO 3
Objective: To introduce TINA tools.	
Additional Experiments	
Task 13: Interpret data sheets of discrete components and IC's	CO 1
Objective: To equip with the knowledge of understanding data sheets of electronic Components.	
Task14: Understand working of various Communication Systems	CO 4
Objective: To provide knowledge in understanding working of various communication Systems.	

Text Book(s):

1. G. Kennedy, B. Davis and Srm Prasanna," Electronic Communication Systems", TMH.
2. R S Khandpur, Printed Circuit Boards- Design Fabrication, Assembly and Testing, Tata Mc Graw Hill Publishing Company Limited, Ist edition 2008 .
3. TINA/ORCAD.PADS software User manual.
4. R.S. Sedha, "A Text Book of Applied Electronics", S. Chand Publication.

Reference Book(s):

1. R.S. Sedha, "A Text Book of Electronic Circuit", S. Chand Publication.
2. Dr K N Hari Bhat and Dr D Ganesh Rao, "Principles of Communication Systems", Cengage India.
3. Raghunandan G H, Raju hajare, "An Introduction to Basic Electronics Concepts and Applications - Concepts and Applications", Cengage Publications

Web References:

1. https://en.wikipedia.org/wiki/Electronic_test_equipment
2. <https://www.electronicshub.org/basic-electronic-components/>
3. <https://www.makerspaces.com/basic-electronics/>
4. <https://predictabledesigns.com/electronic-lab-setup-tools-and-equipment-requirements/>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1505	ENGINEERING & ITWORK SHOP						R2020	
PART – A ENGINEERING WORK SHOP								
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P			C	CIE	SEE
II	0	0	4	64	2	40	60	100
Pre-requisite: Basic mathematics.								
Course Objectives:								
1. To know basic workshop processes and adopt safety practices while working with various tools and equipments								
2. To identify, select and use various marking, measuring, holding, striking and cutting tools & equipments.								
3. To know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system								
4. To gain knowledge about the usage of tools like Word processors, Spreadsheets, Presentations								
5. To learn about Networking of computers and use Internet facility for Browsing and Searching								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO1	Understand the safety aspects in using the tools and equipments. (BL-2)							
CO2	Apply tools for making models in respective trades of engineering workshop. (BL-3)							
CO3	Apply basic electrical engineering knowledge to make simple house wiring circuits and check their functionality. (BL-3)							
CO4	Understand to disassemble and assemble a Personal Computer and prepare the computer ready to use (BL-2)							
CO5	Apply knowledge to Interconnect two or more computers for information sharing (BL-3)							
COURSE CONTENT (TRADES FOR PRACTICE)								
Trade -1 Carpentry								
Familiarity with different types of woods and tools used in wood working and make following joints from out of 300x40x25mm soft wood stock.								
a) Half-Lap joint. b) Mortise and Tenon joint								
Trade-2 Fitting								
i. Familiarity with different types of tools used in fitting and do the fitting exercises out of 80 x 50 x 5 mm M.S. stock a) V-fit b) Dovetail fit								
Trade - 3 Sheet Metal Work								
Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from out of 22 or 20 gauge G.I. sheet a) Tapered tray b) Conical funnel								
Trade - 4 Electrical House Wiring								
Familiarities with different types of basic electrical circuits and make the following electrical connections a) Two lamps in series b) Two way switch c) Tube light d) Two lamps in parallel with 3 pin plug and switches								

Trade 5 – Welding

Familiarity with different types of tools used in welding and do the following welding exercises

1. Single V butt joint
2. Lap joint

Text Book(s):

1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjar Roy S.K. “Elements of Workshop Technology” Vol-I 2008 & Vol-II 2010 Media Promoters & Publishers Pvt. Limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid, “Manufacturing Engineering and Technology” 4th Edition, Pearson Education India Edition, 2002.
3. P. Kannaiah & K. L. Narayana “Workshop manual” 2nd Ed., Scitech publications Pvt. Ltd., Hyderabad, 2008.

Reference Book(s):

1. Gowri P., Hariharan and Suresh Babu A., “Manufacturing Technology-I”, Pearson Education 2008.

Web Resources:

1. <https://www.muett.edu.pk/sites/default/files/images/users/41/Workshop%20Intro.pdf>
2. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=98826>

PART-B IT WORKSHOP LAB

Course Objectives:

1. To provide Technical training on Productivity tools like Word processors, Spreadsheets, Presentations.
2. To make the students know about the internal parts of a computer, assembling, installing the operating system.
3. To teach connecting two or more computers.

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

CO 1	Understand functionalities of a computer and operating system. (BL-2)
CO 2	Practice Word processors, Presentation and Spreadsheet tool.(BL-2)
CO 3	Connect computer using wired and wireless connections.(BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1													
CO2	1													
CO3	1													

1: Low, 2-Medium, 3- High

COURSE CONTENT

	CO
Task-1 Learn about Computer	
Identify the internal parts of a computer and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.	CO 1
Task -2 Assembling a Computer	
Disassemble and assemble the PC back to working condition. Troubleshoot the computer and identify working and non-working parts. Identify the problem correctly by various methods available (eg: beeps). Record the process of assembling and trouble-shooting a computer.	CO 1
Task-3 Install Operating system	CO 1
Install Linux, any other operating system (including proprietary software) and make the system dual boot or multi boot. Record the entire installation process.	
Task-4 Operating system features	CO 1
Record various features that are supported by the operating system(s) installed. Submit a report on it. Access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Install new application software and record the installation process.	
Task-5 Word Processor	CO 2
Create documents using the word processor tool. Tasks to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Submit a report of the word processor considered.	
Create documents using the word processor tool. Mail Merge in word processor for creating appointment orders for 10 employee records in excel.	

Task-6 Spreadsheet	CO 2
To create, open, save the spreadsheet and format them as per the requirement. Some of the tasks to be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells, working with pivot tables and charts. Submit a report of the Spreadsheet application considered.	
Task-7 Presentations	CO 2
To create, open, save and run the presentations, Select the style for slides, format the slides with different fonts, colors, create charts and tables, insert and delete text, graphics and animations, bulleting and numbering, hyperlink, set the time for slide show, Record slide show. Submit a report of the Presentation tool considered.	
Task-8 Wired network & Wireless network	CO 3
Select a LAN cable, Identify the wires in the cable, Define the purpose of each wire, Study the RJ45 connector, Use crimping tool to fix the cable to the connector, Test the cable using LAN tester, Connect two or more computers using cross and straight cables, Configure the computers, share the data between the computers.	

Additional Experiments:	
Task -1 IoT	CO 3
Raspberry Pi Study the architecture of Raspberry pi, configure software, Install SD card, Connect the cables, Install Raspbian (or any other) operating system, Configure Wi-Fi, Remotely connect to your Raspberry Pi.	
Task -2 Outlook, Macros	CO 3
Practice the following tasks and submit report A. Configure outlook and access mails. B. Create Macros in word and spreadsheet tools	

Text Book(s): 1. B.Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance",2nd edition, Tata McGraw-Hill, 2002 2. "MOS study guide for word, Excel, Powerpoint& Outlook Exams", Joan Lambert, Joyce Cox, PHI. 3. "Introduction to Information Technology", IITL Education Solutions limited, Pearson Education.
Reference Book(s): 1. Rusen, "Networking your computers and devices", PHI 2. Bigelows, "Trouble shooting, Maintaining & Repairing PCs", TMH.
On-line/Web Resources: https://turbofuture.com/computers/Dissassembling-and-Assembling-the-computer-system https://www.instructables.com/id/Disassemble-a-Computer/ https://www.windowcentral.com/how-do-clean-installation-windows-10 https://www.tutorialspoint.com/ms_excel_online_training/index.asp https://www.raspberrypi.org

NARAYANA ENGINEERING COLLEGE::GUDUR								
20ES1506	PROBLEM SOLVING AND PROGRAMMING LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	0	0	3	30	1.5	40	60	100
Pre-requisite: Mathematics Knowledge, Analytical & Logical Skills								
Course Objectives:								
<ol style="list-style-type: none"> To work with the compound data types To explore dynamic memory allocation concepts To able to design the flowchart and algorithm for real world problems To able to write C programs for real world problems using simple and compound data types To employee good programming style, standards and practices during program development 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Translate algorithms into programs (In C language) (BL - 2)							
CO 2	Code and debug programs in C program language using various constructs. (BL - 3)							
CO 3	Solve the problems and implement algorithms in C. (BL - 3)							
CO 4	Make use of different data types to handle the real time data (BL - 3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2											1	
CO2	2	2	2										2	1
CO3	2	2	3	1	2								2	2
CO4	2	2	3	1	1								2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
Task-1		
<ol style="list-style-type: none"> Practice DOS and LINUX Commands necessary for execution of C Programs. Study of the Editors, Integrated development environments, and Compilers in chosen platform. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment. 		CO 1
Task-2		
<ol style="list-style-type: none"> Practice programs: Finding the sum of three numbers, exchange of two numbers, largest of two numbers, to find the size of data types, Programs on precedence and associativity of operators, sample programs on various library functions. 		CO 1
Task-3		
<ol style="list-style-type: none"> Write a C program to calculate the factorial of a given number Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 & 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence. Write a program to find the roots of a Quadratic equation. 		CO1
Task-4		
<ol style="list-style-type: none"> Write a program to generate the series of prime numbers in the given range. Write a program to reverse the digits of a number. Write a C program to find the sum of individual digits of a positive integer. 		CO 2

Task-5	
1. Write a program to check for number palindrome. 2. Write a program to find the maximum of a set of numbers. 3. Write a C program to find the GCD (greatest common divisor) of two given integers	CO 2
Task-6	
1. Write a program to find the sum of positive and negative numbers in a given set of numbers. 2. Write C code to reverse the elements of the array. For example, [1,2,3,4,5] should become [5,4,3,2,1] 3. Write a C program to find factorial of a given integer number using recursion	CO 3
Task-7	
1. Write a C program that use pointers to find Addition of Two Matrices 2. Write a C program that use functions to find Multiplication of Two Matrices	CO 3
Task-8	
1. Write a program to accept a line of characters and print the number of Vowels, Consonants, blank spaces, digits and special characters. 2. Write a C program to check whether a given string is a palindrome or not, without using anybuilt-in functions.	CO 3
Task-9	
1. Illustrate the use of auto, static, register and external variables. 2. Write a program to read and print student information using structures 3. Write a C program to define a union and structure both having exactly the same numbers using the sizeof operators print the sizeof structure variables as well as union variable	CO 4
Task-10	
1. Write a program to split a “file” into two files, say file1 and file2. Write lines into the ‘file’ from standard input. Read the contents from ‘file’ and write odd numbered lines into file1 and even numbered lines into file2. 2. Write a program to merge two files.	CO 4

Additional Experiments	
Task-1	
1. Programs on bitwise operators. 2. Programs on bit fields.	CO4
Task-2	
1. Write a program to read a set of strings and sort them in alphabetical order. 2. Programs on implementation of structures using files.	CO 4

Virtual Labs:	
1. Problem Solving Lab (IIIT HYDERABAD) : http://ps-iiith.vlabs.ac.in/	
List of Experiments	
1. Numerical Representation 2. Beauty of Numbers 3. More on Numbers 4. Factorials 5. String Operations	6. Recursion 7. Advanced Arithmetic 8. Searching and Sorting 9. Permutation 10. Sequences
2. Computer Programming Lab (IIIT HYDERABAD) : http://cse02-iiith.vlabs.ac.in/	
List of Experiments	
1. Numerical Approximation 2. Functions 3. Advanced Control Flow 4. Arrays 5. Structures	6. Basic Control Flow 7. Pointers 8. Recursion 9. Expression Evaluation

Text Book(s):

1. "How to Solve it by Computer", R.G. Dromey, 2014, Pearson.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education, 1st Edition, 2010.

Reference Book(s):

1. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition, Pearson.
2. "Let us C", YeswantKanetkar, BPB publications
3. "Pointers in C", YeswantKanetkar, BPB publications, 16th Edition, 2017
4. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan& Richard F. Gilberg, 3rd Edition, Cengage Learning
5. C Programming A Problem-Solving Approach, Behrouz A. Forouzan& E.V. Prasad, F. Gilberg, 3rd Edition, Cengage Learning
6. Programming with C RemaTheraja, Oxford, 2018
7. Programming in C, 3rd Edition, 2015, Ashok N. Kamthane, Pearson Education
8. Programming in C, 3/e : A Practical Approach by Ajay Mittal, Pearson Publication
9. Problem Solving with C by SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., PHI Learning, 2nd Edition, 2018
10. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press, 2001
11. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Web Resources:

1. <https://www.includehelp.com/c-programs/advacnce-c-examples.aspx>
2. <https://www.programiz.com/c-programming/examples>
3. <https://www.javatpoint.com/c-programs>
4. <https://www.w3resource.com/c-programming-exercises/>
5. <https://www.sanfoundry.com/simple-c-programs/>
6. <https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx>
7. <http://www.c4learn.com/c-programs/tag/c-programs-typical-programs>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20CH1001	CHEMISTRY (COMMON TO ECE,EEE&CSE)						R2020	
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100
Pre-requisite: Nil								
Course Objectives:								
1. To impart technological aspects of modern chemistry and its applications 2. Understands the chemistry behind electrochemical energy systems 3. To train the students on the principles and applications of polymers 4. Learn analytical methods useful in characterization of compounds.								
Course Outcomes: After successful completion of the course, the student will be able to:								BL
CO 1	understand the fundamental concepts of chemistry to predict the structure and bonding of materials							1
CO 2	Infer the knowledge about various kinds of electro chemical cells.							2
CO 3	Describe various energy storage devices and emerging technologies							2
CO 4	understand the mechanism and applications of different polymers in electronic devices							2
CO 5	familiarize the various sources of renewable energy and their harnessing							2
CO 6	Apply the electromagnetic radiation to the spectroscopy methods for the analysis of engineering							3

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2										1		
CO2	3	2					2					1		
CO3	3	1	2			1	2					2		
CO4	3	2				2	1					1		
CO5	3	1	1			2	1					2		
CO6	3	1										2		

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	STRUCTURE AND BONDING MODELS	8 h
Planks quantum theory, photo electric effect,dual nature of matter -Debroglies equation ,Heisenberg uncertainty principle, molecular orbital theory – bonding in homo- and hetero nuclear diatomic molecules – energy level diagrams of O ₂ and CO, etc. π -molecular orbital's of butadiene and benzene, calculation of bond order, crystal field theory – salient features – splitting in octahedral and tetrahedral geometry.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> 1.Understand the fundamental concepts of chemistry to predict the structure, properties and bonding of Engineering materials.(BL-1) 2.Illustrate the molecular orbital energy level diagram of different molecular species.(BL-2) 3.Apply crystal field theory for octa hydral and tetra hydralmolecule.(BL-3) 4.out line the planks quantum theory. .(BL-2) 5.Explain heisen berg uncertainty principal.(BL-2) 		
MODULE -2	ELECTRO CHEMISTRY	8 h

Electrode potential, EMF of an electrochemical cell, problems on emf Nernst equation;. Electrodes – concepts, reference electrodes (standard hydrogen, Calomel electrode, and glass electrode), potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductometric titrations (acid-base titrations), photovoltaic cell – working and applications.

At the end of the Module 2, students will be able to:

1. Demonstrate competency in the basic concepts of electrochemical cells.(BL-2)
2. Explain the significance of electrode potentials.(BL-2)
3. List the different types of electrodes.(BL-1)
4. Differentiate between , potentiometric and conductometric titrations. (BL-2)
5. Illustrate the construction of PV cell.(BL-2)

MODULE-3	BATTERY TECHNOLOGY	7 h
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Basic concepts, classification of batteries, Important applications of batteries, Modern batteries- zinc air, lithium cells- Li ion cell , Li-MnO₂ cell, ni-cd cell, lead acid storage cell .Fuel cells Introduction- classification of fuel cells – hydrogen and oxygen fuel cell, methanol and oxygen fuel cell, SOFC - Merits of fuel cell

At the end of the Module 3, students will be able to:

1. Classify batteries into different types.(BL-2)
2. Explain the concept involved in the construction of batteries.(BL-2)
3. Identify the significance of batteries. .(BL-3)
4. Compare the merits of different fuel cells.(BL-2)
5. Distinguish between different types of batteries.(BL-2)

MODULE-4	POLYMER CHEMISTRY	9h
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Basic concepts of polymer, chain growth and step growth polymerization, coordination polymerization, copolymerization with specific examples and mechanisms of polymer formation. Plastics - Thermoplastics and Thermosetting, Preparation, properties and applications of –pvc, Bakelite, urea-formaldehyde, Nylons- Elastomers–Buna-S, Buna-N–preparation, properties and applications. Conducting polymers – poly acetylene, poly aniline, mechanism of conduction and applications.

At the end of the Module 4, students will be able to:

- 1 Identify different types of polymers.(BL-3)
2. Distinguish between thermoplastic and thermo setting resins.(BL-2)
3. Explain the preparation, properties and applications of some plastic materials.(BL-2)
4. Apply the knowledge of advanced polymers, conducting polymers for different applications.(BL-3)
5. Outline the properties of polymers and various additives added and different methods of forming plastic materials.(BL-2)

MODULE-5	ENERGY SCIENCE	7 h
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fuels-classification of fuels characteristics solid fuels-coal, analysis of coal ,refining of petroleum, alternative and non conventional sources of Energy-solar, wind, Geo, Hydro power ,Bio mass advantages and disadvantages, Nuclear energy-Nuclear fission and fusion reactions Nuclear waste disposal

MODULE-6	MODULE-VI INSTRUMENTAL METHODS AND APPLICATIONS	9h
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Electronic Spectroscopy –EMR, Beer-Lambert's law and its, Applications, instrumentation of UV-visible spectrophotometer. IR Spectroscopy - Types of vibrations, Instrumentation of IR spectrophotometer and its applications. Chromatography-Introduction ,Principle and instrumentation of Gas Chromatography (GC) and thin layer chromatography, separation of gaseous mixtures and liquid mixtures

At the end of the Module 6, students will be able to:

1. Explain the different types of spectral series in electromagnetic spectrum (BL-2)
- 2 .Understand the principles of different analytical instruments (BL-2)
- 3 .Explain the different applications of analytical instruments (BL-2)
- 4 .Outline the beers lamberts law.(BL-2)

Total hours: 48hours

Content beyond syllabus:

1. Band theory, vulcanization and compounding of rubber

Self-Study:

Contents to promote self-Learning:

S. NO	Topic	CO	Reference
1	Molecular orbital theory	CO1	https://www.youtube.com/watch?v=FMxuss0RXOU
2	Reference electrodes	CO2	https://www.youtube.com/watch?v=WMfXlncyMDc
3	batteries	CO3	https://nptel.ac.in/courses/103/108/103108162/
4	plastics	CO4	https://www.youtube.com/watch?v=FATc12opDCA
5	Non conventional energy resources	CO5	https://swayam.gov.in/nd1_noc20_ge06/preview
6	Fundamentals of spectroscopy	CO6	https://swayam.gov.in/nd1_noc20_cy08/preview

Text Book(s):

1. P.C.Jain&MonikaJain,*Engineering Chemistry*,DhanpatRayPublishingCompany (P) Ltd, New Delhi, 16th edition, 2013.
2. K. N. Jayaveera, G. V. Subba Reddy and C. Ramachandraiah, *Engineering Chemistry*, McGraw Hill Publishers, New Delhi.
3. Energy scenario beyond 2100, by S. Muthu Krishna Iyer.

Reference Book(s):

1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5th edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.
3. Peter Atkins, Julio de Paula and James Keeler, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

Online Resources Web Resources:

1. <https://drive.google.com/file/d/0Bz82vSA0C1x1WC11WkpsTmlwQVk/view>
2. <https://www.cgaspirants.com/2017/08/engineering-chemistry-by-jain-jain.html>
3. <https://www.pdfdrive.com/concise-inorganic-chemistry-d33405948.html>
4. <https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis1/>
2. <https://www.thermalfluidscentral.org/e-books/book-intro.php?b=39file:///C:/Users/DELL/Downloads/HandbookOfInstrumentalTechniquesForAnalyticalChemistryPDFDrive.com.pdf>
3. <https://nptel.ac.in/courses/104/106/104106096/>
4. https://youtu.be/KHh_IX1G6uA
5. <https://www.youtube.com/watch?v=MfbxR9ZDs0s&feature=youtu.be>
6. <https://nptel.ac.in/courses/113/105/113105028/>
7. <https://www.youtube.com/watch?v=15MY7abeCDk>
8. <https://www.youtube.com/watch?v=UeGJpwC1aiQ&feature=youtu.be>

NARAYANA ENGINEERING COLLEGE: GUDUR								
20MA1004	VECTOR CALCULUS & TRANSFORMS(VC&T)							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	1	0	64	4	40	60	100

Pre-requisite: Intermediate Mathematics

Course Objectives:

1. To illustrate the physical interpretation of gradient, divergence and curl
2. To apply the basic concepts of vector integration and their applications.
3. To understand the concepts of Laplace transforms and its properties.
4. To apply the concepts of Laplace, transform to solve the ordinary differential equations.
5. To understand the concepts of Fourier series.
6. To understand the concepts of Fourier transforms and its properties.

Course Outcomes: After successful completion of the course, the student will able to:

CO 1	Interpretate the different operators such as gradient, curl and divergence to find out point function (BL 3)
CO 2	Apply the fundamental theorems of vector integration to evaluate area and volumes. (BL 3)
CO 3	Utilize the concept of the Laplace transforms and convert into time domain to frequency domain. (BL 3)
CO 4	Apply the Inverse Laplace transforms techniques to solve the differential equations. (BL 3)
CO 5	Develop the Fourier Series to the given periodic functions. (BL 3)
CO 6	Make use of Fourier transform to illustrate discrete/continuous function. (BL 3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	
CO2	3	2	2										3	
CO3	3	3	1										2	
CO4	3	3	2										3	2
CO5	3	3	2										2	2
CO6	3	3	2										2	2

1- Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	VECTOR DIFFERENTIATION	9 h
Introduction to vector differentiation , Definition of Scalar and Vector point functions, Definition of Vector differential operator , , Gradient of a Scalar point function- Definition of Gradient of a scalar point function and properties (without proof) , Definition of Directional Derivative , Definition of level surface, Different Problems ,Divergence of a Vector point function - Definition, Definition of Solenoidal vector and problems , Curl of a vector point function - Definition of Curl, definition of Irrotational vector, Problems, Laplacian operator -Definition and related problems,Vector Identities–Statements(without proof).		
At the end of the Module 1, students will be able to:		
1. Understand the concepts of Vector Differentiation.(BL-2)		
2.Apply del to scalar and vector point functions.(BL-3)		
3. Illustrate the physical interpretation of gradient, divergence and curl.(BL-2)		
4.Calculate directional derivatives and gradients (BL-1)		

5. Apply Vector Differentiation concepts in fluid mechanics (BL-3)		
MODULE -2	VECTOR INTEGRATION	11h
Introduction to vector integration , Line integrals-Explanation ,Work done by a Force- Explanation, problems, , Surface integral-Explanation and formula for surface integrals(without proof), Problems, Volume integral- Explanation and formula for volume integral (without proof),Problems ,Green's Theorem-Statement (without proof),Problems , Gauss divergence Theorem- Statement (without proof),Problems, Stoke's theorem - Statement (without proof),Problems.		
At the end of the Module 2, students will be able to:		
1. Find the work done in moving a particle along the path over a force field (BL-1)		
2. Find the rate of fluid flow along and across curves .(BL-1)		
3. Apply Green's, Stokes and Divergence theorem in double and triple integrals.(BL-3)		
4. Use the divergence theorem in physical interpretation of the divergence of a Vector field. (BL-3)		
5. Find the line integrals along simple closed curves on the Plane by Green's Theorem.(BL-1)		
6. Apply Stokes' theorem in physical interpretation of the curl of a vector field. (BL-3)		
MODULE-3	LAPLACE TRANSFORMS	12h
Introduction to Laplace Transforms, Definition of Laplace Transforms, Sufficient conditions for the existence of the L.T of a function, Laplace Transforms of standard Functions, First Translation (or) First Shifting theorem, Problems. Second Translation (or) Second Shifting theorem, Problems. Change of scale property, Problems. L.T .of derivatives, Problems. L.T. of integrals, Problems. Multiplication by 't', Problems. L.T. of Division by 't', Problems. Evaluation of integrals by L.T.- problems. L.T. of some special functions, Unit Step Function or Heaviside's Unit Function- Definition, L.T problems, Unit Impulse Function or Dirac Delta function- Definition, problems. Laplace Transform of Periodic Functions-Statement (without proof), Problems.		
At the end of the Module 3, students will be able to:		
1. Understand the concepts of Laplace transforms.(BL-2)		
2. Solve Ordinary differential equations by Laplace transform techniques. (BL-3)		
3. Find integrals by using Laplace transforms. (BL-1)		
4. Understand the properties of the Heaviside (unit step) function, Dirac delta function and its applications. (BL-2)		
MODULE-4	INVERSE LAPLACE TRANSFORMS	11h
Definition of Inverse Laplace Transforms, Inverse Laplace Transforms of standard Functions (without proof), Problems. Use of Partial Fractions to find Inverse Laplace Transform- problems. First Translation (or) First Shifting theorem- Statement (without proof), problems. Second Translation (or) Second Shifting Theorem-Statement (without proof), Problems. Change of scale property- Statement (without proof), problems. Inverse L.T of derivatives- Statement (without proof), problems. Inverse L.T to finite integrals-Statement (without proof), problems. Multiplication by Powers of s' Statement(without proof),Problems.Division by s' Statement(without proof),problems.Convolution-theorem-statement (without proof), problems. Applications to Ordinary Differential Equations-Working method Explanation, problems.		
At the end of the Module 4, students will be able to:		
1 Understand the concepts of inverse Laplace Transforms (BL-2)		
2 Develop the wave functions by inverse Laplace transforms.(BL-6)		
3 Obtain inverse Laplace transforms by Convolution Theorem (BL-3)		
4 Develop the heat equations by using inverse Laplace transforms (BL-6)		
5 Solve the higher order differential equations by the Laplace transform. (BL-3)		
MODULE-5	FOURIER SERIES	11h

Introduction to Fourier Series, Periodic function-definition, properties(without proof), Euler's formulae(without derivation), Dirichlet's conditions, Fourier series in $[0, 2\pi]$, - formula(without derivation), Problems, Fourier series in $[-\pi, \pi]$ - formula(without derivation), Problems, Fourier series for even and odd functions in $[-\pi, \pi]$ - formula(without derivation), Problems, Fourier series in $[0, 2\pi]$ - formula(without derivation), problems, Fourier series in $[-1, 1]$ - formula(without derivation), problems, Fourier series for even and odd functions in $[-1, 1]$ - formula(without derivation), problems Half -Range Fourier sine Series in $(0, \pi)$ and $(0, 1)$ - Formula(without derivation), Problems, Half-Range Fourier cosine Series in $(0, \pi)$ and $(0, 1)$ -Formula(without derivation), Problems.

At the end of the Module 5, students will be able to:

1. Find the Fourier series expansion of the given function. (BL-1)
2. Apply Fourier series and its properties in various engineering problems. (BL-3)
3. Find the Half-Range Fourier Sine & Cosine series in $(0, \pi)$ and $(0, 1)$. (BL-1)
4. Understand the properties of periodic functions, represent it as a Fourier series (BL-2)

MODULE-6	FOURIER TRANSFORMS	10h
<p>Introduction to Fourier Transforms, Fourier integral theorem Statement (without proof) , Fourier sine and cosine integrals formula(without derivation), problems, Fourier Transform formula(without derivation) & Inverse Fourier Transform formula (without derivation), Properties of Fourier Transforms (without proof), problems , Fourier Sine Transform formula & Inverse Fourier sine Transform formula (without derivation) , problems, Fourier Cosine Transform formula & Inverse Fourier cosine Transform formula (without derivation) , problems, Finite Fourier Sine Transform- Finite Fourier Sine Transform formula & Inverse finite Fourier sine transform formula (without derivation), problems, Finite Fourier Cosine Transform- Finite Fourier Cosine Transform formula & Inverse finite Fourier cosine transform formula (without derivation), problems.</p>		
<p>At the end of the Module 6, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concepts of Fourier transforms. .(BL-2) 2. Apply the properties of Fourier transforms to various engineering problems.(BL-3) 3. Solve boundary value problems by Fourier integral transforms.(BL-3) 5. Make use of the Fourier transforms and its inverse in practical applications of engineering. (BL-3) 		
Total hours:		64hours

Content beyond syllabus: NARAYANA ENGINEERING COLLEGE: GUDUR

1. Orthogonal curvilinear co-ordinates
2. Cylindrical co-ordinates & Spherical polar co-ordinates
3. Complex Fourier series
4. Parseval's Identity for Fourier Transforms.
5. Application of Transforms to Boundary value problems.

Self-Study: Contents to promote self-Learning:

SN	Topic	Reference
1	Vector Differentiation	https://youtu.be/a19x_YG0oLg
2	vector integration	https://youtu.be/pfCwRLK29h4 https://youtu.be/KHiw9Vs-aLM
3	Laplace transforms	https://youtu.be/luJMI37-nso https://youtu.be/EDVJotmT584
4	Inverse Laplace transforms	https://youtu.be/9NqdBXNyJPk https://youtu.be/OZlThUd-yyw
5	Fourier series	https://youtu.be/4cSZDHxyBf4
6	Fourier transforms	https://youtu.be/GtXmS5YH7XM

Text Book(s):

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publication.
3. Ramana B.V., "Higher Engineering Mathematics", McGraw Hill Publishers

Reference Book(s):

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley.
2. Veerarajan T., "Engineering Mathematics", Tata McGraw-Hill.
3. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune.

Online Resources/ Web References:

1. <http://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktuebook-download.html>
2. <http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks>
3. http://www.efunda.com/math/math_home/math.cfm
4. <http://www.ocw.mit.edu/resources/#Mathematics>
5. <http://www.sosmath.com/>
6. <http://www.mathworld.wolfram.com/>

20ES1004	BASIC ELECTRICAL ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100
Pre-requisite: Fundamental of mathematics and physics								
Course Objectives:								
<ol style="list-style-type: none"> To understand Types of electrical elements and KCL & KVL. To analyze Peak and RMS values of AC circuits. To understand Balanced and Unbalanced three Phase AC circuits . Analyze EMF and Torque Equations of DC Machines. To understand the Applications of Transformers and AC Machines. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze DC circuits along with Voltage and Current sources .(BL-4)							
CO 2	Analyze the AC electrical circuits with RLC circuits. (BL-4)							
CO 3	Solve the real and reactive power for a three phase circuit .(BL-3)							
CO 4	Understand the operation and construction of DC machine.(BL-2)							
CO 5	Understand the operation and construction of single and three phase transformer.(BL-2)							
CO 6	Explain the operation and construction of AC Machines.(BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3										2	3
CO2	3	3	3										2	3
CO3	3	3	3	2									3	3
CO4	3	3	3	2									3	3
CO5	2	2	3	2										
CO6	3	3	3	2										

COURSE CONTENT		
MODULE – 1	DC CIRCUITS	8h
Introduction to Voltage, Current, Power, Direct Current (DC), Alternating Current (AC), Difference between DC and AC, Applications of DC and AC - Types of electrical elements – Ohm’s Law - Electrical circuit elements (R, L and C) – Voltage and Current sources – KCL & KVL – Analysis of simple (Series and Parallel) circuits with DC Excitation.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Analysis of Series and Parallel circuits with DC Excitation(BL-2) Understand the Voltage, Current, Power, Direct Current (DC), Alternating Current.(BL-2) Explain the Electrical circuit elements (R, L and C).(BL-2) 		
MODULE -2	AC CIRCUITS	7h
Representation of sinusoidal waveforms – Peak and RMS values – Phasor representation – Real Power, Reactive Power, Apparent Power, Complex Power, Power Factor – Analysis of Single phase AC circuits consisting of R, L, C, RL, RC, RLC series and parallel circuits.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Understand the Representation of sinusoidal waveforms, Peak and RMS values, Phasor representation of AC network. (BL-2) Solve the Reactive Power, Apparent Power, Complex Power, Power Factor of a AC circuits. (BL-3) Explain the Single phase AC circuits.(BL-2) 		

MODULE -3	NETWORK THEOREMS	9h
Super position theorem, Compensation theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Reciprocity theorem; Application of network theorems in solving DC and AC circuits.		
At the end of the Module 3, students will be able to: <ol style="list-style-type: none"> 1. Understand the Application of network theorems in solving DC circuits. (BL-2) 2. Understand the Application of network theorems in solving AC circuits. (BL-2) 3. Explain various theorems. (BL-2) 		
MODULE -4	DC MACHINES	8h
Principle of operation of DC Generator - EMF Equation – Types of Generators – Magnetization and Load Characteristics – Applications – Principle of operation of DC Motor – Torque Equation – Types of Motors – Characteristics – Applications.		
At the end of the Module 4, students will be able to: <ol style="list-style-type: none"> 5. Explain the Types of Generators. (BL-2) 6. Understand the Characteristics and Applications of DC Machines. (BL-2) 7. Explain the Torque Equation and Types of Motors. (BL-3) 		
MODULE -5	TRANSFORMERS	8h
Principle of operation of Single phase Transformer – Types – EMF Equation – Applications – Three phase AC Circuits (Balanced and Unbalanced) - Principle of operation of three phase Transformer – Application – Selection of single phase or three phase transformer at consumer premises.		
At the end of the Module 5, students will be able to: <ol style="list-style-type: none"> 1. Explain the types of Transformer. (BL-2) 2. Explain the Applications of Transformer. (BL-2) 3. Understand the single phase and three phase transformer at consumer premises. (BL-2) 		
MODULE-6	AC MACHINES	8h
Principle of operation of Alternator – Characteristics- applications – Principle of operation of single phase Induction Motor – Characteristics – Applications - Principle of operation of three phase Induction Motor – Characteristics – Applications.		
At the end of the Module 6, students will be able to: <ol style="list-style-type: none"> 1. Understand the concept of different type of AC machines. (BL-2) 2. Understand the Characteristics and Applications of AC Machines. (BL-3) 3. Explain the Principle of operation of three phase Induction Motor. (BL-2) 		
Total hours:		48 hours

Content beyond syllabus:

- Introduction to PSpice.
- Starting Methods of Polyphase Induction Motors
- Brake test of DC Motor

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Introduction to the electrical circuit	https://nptel.ac.in/courses/117/106/117106108/
2	AC circuit	https://nptel.ac.in/courses/108/105/108105053/
3	DC Generators	https://nptel.ac.in/courses/108/102/108102146/ https://nptel.ac.in/courses/108/105/108105017/#
4	D.C Motors	http://vidyimitra.inflibnet.ac.in/index.php/search?subject%5B%5D=Electrical&course%5B%5D=Electromagnetic+Fields&domain%5B%5D=Engineering+and+Technology

5	Single-phase transformers	https://web.digimat.in/#electrical-engineering
6	Polyphase Induction Motors	https://nptel.ac.in/courses/108/102/108102146/ https://nptel.ac.in/courses/108/105/108105131/

Text Book(s):

1. A Sudhakar and Shyam Mohan SP, “Circuits and Networks: Analysis and Synthesis”, TMH, 5th Edition, New Delhi, 2015.
2. Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija Oxford University Press..

Reference Book(s):

- 1.S.Sivanagaraju, G.Kishor&C.Srinivasa Rao, "Electrical Circuit Analysis", Cengage Learning, 1st Edition, 2010.
2. A .Chakrabarti : Circuit Theory (Analysis and Synthesis), Dhanpat Rai &Co
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013
4. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004
5. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015.

Online Resources / Web Reference:

1. <http://175.101.102.82/moodle/>
2. <https://www.accessengineeringlibrary.com/>
3. <https://nptel.ac.in/courses/108/105/108105066/>
4. <https://nptel.ac.in/courses/108/105/108105159/>
5. <https://nptel.ac.in/courses/108/102/108102042/>
6. [https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-21\(TB\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-21(TB)(ET)%20((EE)NPTEL).pdf)
7. https://www.researchgate.net/publication/329252017_Analysis_Study_In_Principles_Of_Operation_Of_Dc_Machine
8. <https://nptel.ac.in/courses/108/102/108102146/>
9. http://www.ijrimsec.com/assoc_art/volume7_1/Ch_10.pdf
10. <https://www.engineering.com/>
11. <http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm>
12. <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-7ndelectronics-spring-2007/video-lectures/lecture-2/>
- 13 <http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1007	INTRODUCTION TO PYTHON PROGRAMMING							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
II	2	0	0	32	2	40	60	100

Pre-requisite: Knowledge of Mathematics and Basic Programming Language

Course Objectives:

1. To learn the fundamentals of python.
2. To implement python programs for conditional loops and functions.
3. To handle the compound data using python lists, tuples, sets, dictionaries.
4. To learn the files, modules, packages concepts.
5. To introduce the concepts of class and exception handling using python.
6. To train in regular expression concepts.

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

CO 1	Summarize the fundamental concepts of python programming. (BL - 2)
CO 2	Apply the basic elements and constructs the python to solve logical problems.(BL-3)
CO 3	Organize data using different data structures of python .(BL - 3)
CO 4	Implement the files modules and packages in programming. (BL - 3)
CO 5	Apply object oriented &exception handling concepts to build simple applications.(BL - 3)
CO 6	Implement the concepts ofTurtle Graphics. (BL - 3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2											1	
CO2	2	3	1	2									1	1
CO3	2	2	2	2	2							2	2	
CO4	2	2	2	1	1							1	3	2
CO5	2	2	2	1								1	2	2
CO6	2	1	2	1								1	2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION TO PYTHON	5h
Introduction: History of Python, Features of Python Programming, Applications of PythonProgramming, Running Python Scripts, Comments, Typed Language, Identifiers, Variables, Keywords, Input/output, Indentation, Datatypes, Type Checking, range(), format(), Math module.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Learn the basics of python. (BL - 1) 2. Write the python programs. (BL - 1) 3. Understand concept of type checking. (BL - 2) 		
MODULE -2	OPERATORS EXPRESSIONS AND FUNCTIONS	5 h
Operators and Expressions: Arithmetic, Assignment, Relational, Logical, Boolean, Bitwise, Membership, Identity, Expressions and Order of Evaluations, Control Statements.		
Functions: Introduction, Defining Functions, Calling Functions, Anonymous Function, Fruitful Functions and Void Functions, Parameters and Arguments, Passing Arguments, Types of Arguments, Scope of variables, Recursive Functions.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Solve the problems using operators, conditional and looping. (BL - 3) 2. Solve the problems using the functions. (BL -3) 3. Apply the principle of recursion to solve the problems. (BL-3) 		
MODULE-3	STRINGS, LISTS,TUPLES, AND DICTIONARIES	6h
Strings, Lists, Tuples, and Dictionaries: Strings-Operations, Slicing, Methods, List-Operations, slicing, Methods, Tuple- Operations, Methods, Dictionaries- Operations, Methods, Mutable Vs Immutable, Arrays Vs Lists, Map, Reduce, Filter, Comprehensions.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Write programs for manipulating the strings. (BL - 1) 2. Understand the knowledge of data structures like Tuples, Lists, and Dictionaries.(BL - 2) 3. Select appropriate data structure of Python for solving a problem.(BL -3) 		
MODULE-4	FILES, MODULES AND PACKAGES	6h
Files, Modules and Packages: Files- Persistent, Text Files, Reading and Writing Files, Format Operator, Filename and Paths, Command Line Arguments, File methods, Modules- Creating Modules, Import Statement, Form.Import Statement, namespacing, Packages- Introduction to PIP, Installing Packages via PIP(Numpy).		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concepts of files. (BL - 2) 2. Implement the modules and packages. (BL - 3) 3. Organize data in the form of files.(BL - 3) 		
MODULE-5	OBJECT ORIENTED PROGRAMMING, ERRORS AND EXCEPTIONS	5h
OOP in Python: Object Oriented Features, Classes, self variable, Methods, Constructors, Destructors, Inheritance, Overriding Methods, Data hiding, Polymorphism.		
Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Apply object orientation concepts.(BL -3) 2. Apply the exception handling concepts. (BL -3) 3. Implement OOPs using Python for solving real-world problems.(BL -3) 		
MODULE-6	TURTLE GRAPHICS	5h
Turtle Graphics: Move and Draw, Turtle Operations, Turtle object, Simple Graphics, The Vagrant, The Beautiful Patterns, Drawing with Colors.		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concepts of Turtle Graphics. (BL -2) 2. Develop GUI applications using Python. (BL -3) 		
Total hours:		48Hours

Content Beyond Syllabus: Testing, GUI Programming, Matplotlib, Databases.

Self-Study:

Contents to promote self-Learning:

SNo	Module	Reference
1	Introduction to Python	https://www.youtube.com/watch?v=WvhQhj4n6b8
		https://www.youtube.com/results?search_query=History+of+Python%2C+Features+of+Python+Programming%2C+Applications+of+Python+Programming%2C+Running+Python+Scripts%2C+Comments+in+edureka
		https://www.youtube.com/watch?v=9F6zAuYtuFw
		https://www.youtube.com/watch?v=yHFcNNh-SsA

		https://www.youtube.com/watch?v=FuPHs7GLxq8
		https://www.youtube.com/watch?v=6yrsX752CWk
		https://nptel.ac.in/courses/106/106/106106145/ [Lec - 27 &30]
		https://www.youtube.com/watch?v=0Hp7AThTZhQ
		https://www.youtube.com/watch?v=fy10ci10R_g
		https://nptel.ac.in/courses/106/106/106106145/ [Lec - 11]
		https://nptel.ac.in/courses/106/106/106106145/ [Lec - 5]
2	Operators, Expressions and Functions	https://www.youtube.com/watch?v=Pm9FOpOwhlA&t=143s https://nptel.ac.in/courses/106/106/106106145/ [Lec - 9]
		https://www.youtube.com/watch?v=oSPMmeaiQ68&t=51s https://nptel.ac.in/courses/106/106/106106145/ [Lec - 24]
3	Strings, Lists, Tuples, and Dictionaries	https://nptel.ac.in/courses/106/106/106106145/ [Lec - 6]
		https://nptel.ac.in/courses/106/106/106106145/ [Lec - 7, 12 &23]
		https://www.youtube.com/watch?v=MEPILAjPvXY
4	Files, Modules and Packages	https://nptel.ac.in/courses/106/106/106106145/ [Lec - 28]
5	Object Oriented Programming, Errors and Exceptions	https://nptel.ac.in/courses/106/106/106106145/ [Lec - 26, 37 &38]
6	Turtle Graphics	https://www.youtube.com/watch?v=WQIKPdKVXfw https://www.youtube.com/playlist?list=PLzgPDYo_3xumT2sfELR4_YV3aojaxkUC9

Text Book(s):

1. VamsiKurama, Python Programming: A Modern Approach, Pearson, 2017.
2. Allen Downey, Think Python, 2nd Edition, Green Tea Press

Reference Books :

1. R. Nageswara Rao, "Core Python Programming", 2nd edition, Dreamtech Press, 2019.
2. Allen B. Downey, "Think Python", 2nd Edition, SPD/O'Reilly, 2016.
3. Martin C. Brown, "The Complete Reference: Python", McGraw-Hill, 2018.
4. Mark Lutz, Learning Python, 5th Edition, O'Reilly, 2013.
5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007
6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015

Online Resources / Web Resources:

1. <https://www.datacamp.com/learn-python-with-anaconda/>
2. <https://www.codecademy.com/learn/paths/data-science?>
3. <https://www.coursera.org/courses?query=python>
4. <https://www.edx.org/learn/python>
5. <https://training.crbtech.in/neo/online-it-training-programme.php?>
6. <https://www.tutorialspoint.com/python/index.htm>
7. <https://www.w3schools.com/python/>
8. <https://www.javatpoint.com/python-tutorial>
9. <https://www.geeksforgeeks.org/python-programming-language/>
10. <https://www.learnpython.org/>
11. <https://docs.python.org/3/>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20CH1501	CHEMISTRY LAB (COMMON TO ECE,EEE&CSE)							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100
Pre-requisite: Nil								
Course Objectives: The objective of the laboratory sessions is to enable the learner to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	determine the cell constant and conductance of solutions							
CO 2	Perform quantitative analysis using instrumental methods							
CO 3	utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification\ and Spectroscopy							
CO 4	analyze and gain experimental skill.							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	3													
CO3	3													
CO4	3													

1: Low, 2-Medium, 3- High

COURSE CONTENT		CO
Task-1 : Conductometric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base		
Objective 1. perform a conductometric titration of a mixture of strong acid and weak acid with a strong base, 2. determine the equivalence point of the titration by plotting titration curve using conductance values and amount of the base added during titration, 3. state the advantages conductometric titrations,		CO2
Task-2 : Determination of cell constant and conductance of solutions		
Objective: 1. To determine conductivity of the given water sample. by using conductivity meter 2. To understand the specific conductance.		CO 1
Task-3- Verify Lambert-Beer's law		
Objective: 1. To use spectroscopy to relate the absorbance of a colored solution to its concentration. 2. To prepare a Beer's Law Plot to determine the concentration of an unknown.		CO 2
Task-4: pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base		
Objective: 1. To perform a potentiometric titration of an acidic solution of known molarity. 2. To graph the volume of base added vs the pH and to determine the equivalence point 3. To calculate the molarity of the basic solution		CO 2

Task-5: Estimation of Ferrous Iron by Dichrometry.	
Objective: 1. determine the percentage of ferrous iron in an unknown sample by redox titration with potassium dichromate solution . 2.The student will pre-treat the sample to obtain the iron in the reduced(+2 oxidation) state. 3.The student will use a solution of primary standard as the titrant	CO 3
Task-6 : Potentiometry - determination of redox potentials and emfs	
Objective: 1. Determine the concentration of an unknown iron(II) solution. By using potentiometer 2. Discuss how the potential changes with relative concentration of oxidised/reduced form, 3. perform a redox titration of ammonium iron (II) sulphate using potassium dichromate as oxidizing agent, 4. determine the equivalence point of the redox titration by plotting titration curve using potential change values and amount of oxidizing agent added during titration,	CO 3
Task-7 : Preparation of a polymer	
Objective: To prepare phenol formaldehyde resin. (Bakelite) 1. Understand the differences between linear and cross linked polymers. 2. Compare and contrast the recycling properties of linear and cross linked polymers. 3. Compare the combustion properties of various types of material. 4. Define the following terms: polymer, monomer, repeat unit, cross linking, biopolymer	CO 4
Task-8: Thin layer chromatography	
Objective: 1.To separate spinach pigments using thin layer chromatography 2.To describe the method of chromatography and its applications	CO 2
Task-9: Identification of simple organic compounds by IR	
Objective: 1.To learn various function groups encountered in organic chemistry 2.To learn important role of IR spectroscopy in the study of structure of organic compounds 3.To develop skill in the recognition of characteristic absorption bands 4.to identify compound by an investigation of its IR spectrum	CO 3
Task-10 : Determination of Strength of an acid in Pb-Acid battery	
Objective: 1.To determine the half –reactions involved in spontaneous oxidation –reduction reactions. 2. Explain the function of the lead storage and dry cell batteries ...electrolysis involving two lead strips immersed in sulfuric acid.	CO 4
Additional Experiments:	
Task-11 : Measurement of $10Dq$ by spectrophotometric method	
Objective 1. The purpose of the experiment is three-fold. First, the student verifies that the spectrochemical series 2. based on this model are generally in poor agreement with experimental values obtained from visible spectra (3). However, because of the octahedral symmetry it is true that the splitting of the d levels predicted by crystal field theory is qualitatively correct.	CO 4
Task-12 : Models of potential energy surfaces	
Objective: 1. Distinguish between potential energies and potential energy surfaces (PESs). 2. Identify the saddle point, the reactant and product valleys and plateaus on the contour diagram of PESs 3. Distinguish between attractive and repulsive potential energy surfaces.	CO4

Virtual Labs:	
1. http://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1	
2. http://vlab.amrita.edu/?sub=2&brch=190&sim=339&cnt=1	
3. http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1	

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	Estimation of Ferrous Iron by Dichrometry.	CO 1	https://www.youtube.com/watch?v=LxgZsMhuyNM
2	Paper chromatography	CO 1	https://www.youtube.com/watch?v=NsI9vJMphKk
	Preparation of polymer	CO 4	https://www.youtube.com/watch?v=PSSK5VGcC_0

Text Book(s):

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Jain & Jain. Engineering Chemistry: Dhanapathrai Publications.,2015.
3. S.S.Dara, Experiments and Calculations in Engineering Chemistry: S-Chand Publications, Revised edition,2008.

Reference Book(s):

1. S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.
2. Sunitha Rattan, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition.

Web References:

1. <https://nptel.ac.in/courses/122101001/23>
2. <https://nptel.ac.in/courses/104103071/39>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1509	BASIC ELECTRICAL ENGINEERING LAB							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	0	0	2	32	1	40	60	100
Pre-requisite: Basic knowledge of Electrical circuits and Machines								
Course Objectives:								
1. To Verification of KCL, KVL and Superposition theorem.								
2. To conduct testing on DC and AC Machines.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Verify basic Kirchhoff's laws and solving Electrical Circuits(BL-1)							
CO 2	Analyze the simple DC circuits using Pspice(BL-3)							
CO 3	Understand the performance characteristics of DC Machines. (BL-2)							
CO 4	Understand the performance characteristics of AC Machines (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1										2	3
CO2	2	2	2										2	3
CO3	3	2	2										2	3
CO4	3	3	2										2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT														CO	
PART-A															
Task 1 - Verification of Kirchhoff laws.															
Objectives:														CO 1	
a) To Verify the KCL															
b) To Verify the KVL															
Task -2 Determine Real and Reactive power for a given RLC circuits															
Objectives:														CO 1	
a) To find Real and Reactive power for a given RLC circuits															
Task-3 Brake test on DC shunt motor. Determination of performance curves.															
Objectives:Plot the following characteristics														CO 3	
i) Efficiency Vs Output															
ii) Line current Vs Output															
iii) Speed Vs Output															
iv) Torque Vs Output															
v) Line current Vs Torque															
Task-4 Speed Control of DC shunt motor.															
Objectives:Plot the following characteristics														CO 2	
i) To Control the speed of DC Motor by Armature Control Method.															
ii) To Control the speed of DC Motor by Field Control Method.															
Task-5 O.C. & S.C. Tests on Single phase Transformer.															
Objectives: Predetermination of the following														CO 4	
a) Efficiency at different load conditions and different power factors															
b) Regulation at different load conditions and different power factors															
c) Output vs. Efficiency curves															

Task 6 - Brake Test on Three Phase Induction Motor.			
Objectives: To determine the performance characteristics, a) Efficiency Vs Output b) Line current Vs Output c) Speed Vs Output d) Torque Vs Output			CO 3
Task 7 - Measurement of current in various branches and verify by calculation. Drawing of phasor diagram.			
Objectives: To verify the series and parallel RLC circuits			CO 1
Task 8-Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed			
Objectives: a) Predetermine the OCC at different speeds b) Determine the critical field resistance c) Obtain critical speed for a given shunt field resistance			CO 3
Task 9-Swinburne's test on Dc machine			
Objectives: Todetermine the Efficiency of DC motor and Generator			CO 3
Task 10 -Load test on DC shunt generator. Determination of characteristics.			
Objectives: a) Determine the external & internal characteristics b) Deduce the armature reaction curve			CO 3
Task 11 - Simulation of DC Circuits			
Objectives: To simulate a simple DC circuits using PSpice			CO 2
Task 12 -Mesh and Nodal Analysis			
Objectives: To simulate a simple DC circuits using PSpice			CO 2
Virtual Labs: 1. Speed Control of DC Motor By Varying The Armature And Field Resistances. 2. Conduct OC and SC Test on Single Phase Transformer. 3. Conduct Brake test on 3-phase induction motor.			
Self-Study: Contents to promote self-Learning:			
SN	Topic	CO	Reference
1	Kirchoff's Laws & Superposition theorem.	CO1	https://www.youtube.com/watch?v=S-bbn0ZQ7is
2	simple DC circuits using Pspice	CO2	https://www.csun.edu/~skatz/pspice_tutorials/pspice_tutorial_1.pdf
3	The performance characteristics of DC motors.	CO3	https://www.youtube.com/watch?v=kOj8dA9cKXo
4	The performance characteristics of AC motors.	CO4	https://www.youtube.com/watch?v=CaSdKCwlSLE

Text Book(s):

1. Basic Electrical and Electronics Engineering, M.S.Sukhija, T.K.Nagsarkar, Oxford University.
2. Basic Electrical and Electronics Engineering, S.K Bhattacharya, Pearson Education, 2012

Web Resources:

1. [https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-41\(TB\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-41(TB)(ET)%20((EE)NPTEL).pdf)
2. <https://nptel.ac.in/courses/108/102/108102146/>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1504	ENGINEERING GRAPHICS LAB							R2020
Semester	Hours / Week			Total hrs	Credits C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	0	1	4	80	3	40	60	100
Pre-Requisite: Basic Mathematics(Geometry)								
Course Objectives:								
1. To impart skills on using drawing instruments								
2. To convey exact and complete information of any physical object.								
3. To Construct Engineering Curves.								
4. To Learn and practice basic AutoCAD commands.								
5. To Instruct the utility of drafting & modelling packages in orthographic and isometric drawings								
6. To understand the applications of AUTOCAD for modeling physical objects								
Course Outcomes: At the end of the course, student will be able to:								
CO1	Define the qualities of precision and accuracy in engineering drawing.(BL-1)							
CO2	Draw engineering curves with different methods(BL-3).							
CO3	Develop the orthographic projection of points and straight lines(BL-3)							
CO4	Construct the planes and simple solids.(BL-3).							
CO5	Understand and practice basic AUTOCAD commands(BL-2)							
CO6	Construct isometric views using AUTOCAD(BL-3).							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2				1							1	1	1
CO2	2	1			1							1	1	2
CO3	2	2			1							2	2	2
CO4	2	2			2	1						2	2	2
CO5	1	1	1		1							1	1	3
CO6	2	2	2		2							1	2	3
1:Low,2-Medium,3-High														

COURSE CONTENT		
Part-A Manual Drawing		
TASK– 1	Introduction and Conic sections	10h
<p>Introduction to Engineering graphics: Principles of Engineering Graphics and their significance; various instruments used, drawing sheet sizes and title block, lettering, BIS conventions, types of lines and dimensioning methods. Geometrical constructions: simple constructions, construction of Pentagon, Hexagon by general method only.</p>		
<p style="text-align: center;">Conic Sections: Types of conics: Ellipse, Parabola and Hyperbola (Eccentricity method only), At the end of the TASK-1, students will be able to:</p>		
<ol style="list-style-type: none"> 1. Understand of Geometrical Constructions. (BL-2) 2. Draw Conic Sections by using eccentricity method. (BL-3) 		
TASK--2	Orthographic Projections	11h
<p>Objectives and Principle of projection, Methods of projections, Comparison between first angle and third angle projection. Projections of points: Projection of points placed in different quadrants, Projection of straight lines: Fundamental concepts, Line parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only, Projections of planes: Projection of planes (Triangle, Square, Pentagon, Circle) parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only</p>		
<p>At the end of the TASK- 2, students will be able to:</p>		
<ol style="list-style-type: none"> 1. Understand Orthographic Projection of points. (BL-2) 2. Draw Projection of lines inclined to one and two reference planes. (BL-3) 3. construct the Projection of planes inclined to one and two reference planes. (BL-3) 		
TASK–3	Projections of Solids	13 h
<p>Types of solids ; Polyhedra, Solids of revolution, Projections of regular solids (Prisms, Pyramids, Cylinders and Cone), with its axis perpendicular to one plane and parallel to other plane, Axis inclined to one plane and parallel to other plane.</p>		
<p>At the end of the TASK-3, students will be able to:</p>		
<ol style="list-style-type: none"> 1. Understand Projections of regular Solids. (BL-2) 2. Draw projection of Prisms, Pyramids, Cylinders And Cones (BL-3) 		
TASK–4	Isometric and Orthographic views	11h
<p>Isometric Projections : Principles, Isometric scale, Isometric views, Conventions, Isometric views of lines, planes, simple solids (Cube, Cylinder, Cone), Conversion of Isometric views to Orthographic views.</p>		
<p>At the end of the TASK-4, students will be able to:</p>		
<ol style="list-style-type: none"> 1. Understand Principles of Isometric Projections and Isometric scale. (BL-2) 2. Draw isometric views of simple solids (BL-2) 3. Apply the principles in Conversion of Isometric views into Orthographic views. (BL-3) 		
Part B Computer Aided Drafting		
TASK–5	Introduction to AutoCAD	16 h
<p>Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.</p>		
<p>At the end of the TASK- 5, students will be able to:</p>		
<ol style="list-style-type: none"> 1. Understand the Basic AutoCAD commands. (BL-2) 2. Draw the templates of simple physical objects. (BL-3) 3. Apply the utility of drafting & modelling packages in orthographic and isometric drawings 		

TASK-6	Orthographic and Isometric Projections	19 h
Transformation of Isometric Projections into orthographic projections such as simple solids such as cylinder, cone, square prism, pentagonal pyramid Draw 3D model of mechanical components such as Stepped block, Bush bearing, At the end of the TASK-6 , students will be able to:		
<ol style="list-style-type: none"> 1. Develop the usage of 2D and 3D modelling. (BL-3) 2. Create the various views of machine components. (BL-3) 		
		Total H: 80 hours
Content beyond syllabus:		
1. Development of surfaces, Section of solids		
Text Book(s):		
<ol style="list-style-type: none"> 1. Bhatt N.D. "Elementary Engineering Drawing", Charotar Publishers, 2014. 2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009 3. K.L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012. 4. Engineering Drawing by Dr AVS Sridhar Kumar, Dr Krishnaiah, T P Vara Prasad, Spectrum education, Sun techno Publications, 2019 		
Reference Book(s):		
<ol style="list-style-type: none"> 1. Engineering Drawing and Graphic Technology -International Edition, Thomas E. French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, 2014 2. Venugopal.K "Engineering Drawing and Graphics", New Age International (P) Ltd., New Delhi, 2010. 		
Online Resources:		
<ol style="list-style-type: none"> 1. www.nptel.ac.in/courses/112104019/ 2. www.nptel.ac.in/courses/105104148/ 3. www.vlab.co.in 		
Web Resources:		
<ol style="list-style-type: none"> 1. https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf 1. http://cbseacademic.nic.in/web_material/CurriculumMain21/SrSecondary/Engineering_Graphics_Sr_Sec_2020-21.pdf 2. http://cbseacademic.nic.in/web_material/Curriculum19/Main-/11_Engineering_Graphics.pdf 		

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1510	INTRODUCTION TO PYTHON PROGRAMMING LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
II	0	0	2	32	1	40	60	100
Pre-requisite: Programming Knowledge								
Course Objectives:								
<ol style="list-style-type: none"> To gain knowledge on python programs basics To prepare students for solving the programs on functions, data structures, Files To prepare students for solving the programs on Classes, Exception Handling, Regular Expressions and Multi threading 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO1	Understanding and use of python- Basic Concepts(BL -2)							
CO2	Solve the concepts of python functions and data structures(BL -3)							
CO3	Understand the concepts of files, modules, multithreading and regular expressions(BL -2)							
CO4	Solve the concepts of class and exception handling (BL -3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2										1	
CO2	2	3	2	2									2	1
CO3	2	2	3	2	2								3	2
CO4	2	2	2	1	1								3	2
1-Low, 2-Medium, 3- High														

COURSE CONTENT														CO
Task-1 - Python Basics														
<ol style="list-style-type: none"> Running instructions in Interactive interpreter and a Python Script Write a program to purposefully raise Indentation Error and Correct it Write a program to compute distance between two points taking input from the user (Pythagorean Theorem) Write a program to convert a Binary number to Decimal number and verify if it is a Perfect number. 														CO 1
Task-2 - Conditional Statements														
<ol style="list-style-type: none"> Write a program to determine if a given string is a Palindrome or not Write a program for Fibonacci sequence is generated by adding the previous two terms by starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ... 														CO 1
Task-3 - Functions														
<ol style="list-style-type: none"> Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding. Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance between two balls centers) <= (sum of their radii) then (they are colliding) 														CO 2
TASK-4 - Functions Continued														
<ol style="list-style-type: none"> Write a function that draws a Pyramid with # symbols 														CO 2

<pre style="text-align: center;"># # # # # # # # # # # # # # # #</pre> <p>2. Choose any five built-in string functions of C language. Implement them on your own in Python. You should not use string related Python built-in functions.</p>	
TASK-5 - Strings	
<p>1. Write a program to use split and join methods in the string and trace a birthday with Diction b array data structure.</p> <p>2. Write a program using map, filter and reduce functions</p>	CO 2
TASK-6 - Lists	
<p>1. Write program which performs the following operations on list's. Don't use built-in functions</p> <ul style="list-style-type: none"> a) Updating elements of a list b) Concatenation of list's c) Check for member in the list d) Insert into the list e) Sum the elements of the list f) Push and pop element of list g) Sorting of list h) Finding biggest and smallest elements in the list i) Finding common elements in the list 	CO 2
TASK-7 - Files (
<p>1. Write a program to print each line of a file and count the number of characters, words and lines in a file.</p> <p>2. Write a program that allows you to replace words, insert words and delete words from the file.</p>	CO 3
TASK-8 - Modules and Packages	
<p>1. Write a program for creating a module and import a module</p> <p>2. Write a program to perform any two operations using Numpy</p>	CO 3
TASK-9-Class and Objects	
<p>1. Write a program for Class variables and instance variable and illustration of the self variable</p> <ul style="list-style-type: none"> i) Robot ii) ATM Machine 	CO 4
TASK-10 - Exception Handling	
<p>1. Write a program of exception handling to open a file while do not have write permissions</p> <p>2. Write a Programto handle multiple errors with one except statement.</p>	CO 4
TASK-11- Regular Expressions	
<p>1. Write a Python program to remove the parenthesis area in a string. Sample data : ["example (.com)", "w3resource", "github (.com)", "stackoverflow (.com)"]</p> <p>2. Write a program to match the name phone , emails, passwords and phone numbers using pattern matching</p>	CO 3
TASK-12-Turtle	
<p>1. Write a turtle program to construct a clock dial</p> <p>2. Write a turtle program to produce a flower in different colours</p>	CO 3

Additional Experiments	
TASK-1	
1. Write a python program to find the resolution of an image 2. Write a python program to count the number of vowels and consonants 3. Write a python program to print the ASCII value of a character	

Virtual Labs:	
Python Lab (IIT Bombay) : http://vlabs.iitb.ac.in/vlabs-dev/labs/python-basics/experimentlist.html	
List of Experiments	
1. Arithmetic Operations 2. Built-in Functions 3. Loops 4. Data Types 5. Strings	6. Classes and Objects 7. Built-in Modules 8. Constructors and Inheritance 9. File Operators

Text Book(s):
1. Vamsi Kurama, Python Programming: A Modern Approach, Pearson, 2017. 2. Allen Downey, Think Python, 2nd Edition, Green Tea Press
Reference Books :
1. R. Nageswara Rao, "Core Python Programming", 2nd edition, Dreamtech Press, 2019. 2. Allen B. Downey, "Think Python", 2nd Edition, SPD/O'Reilly, 2016. 3. Martin C. Brown, "The Complete Reference: Python", McGraw-Hill, 2018. 4. Mark Lutz, Learning Python, 5th Edition, Orielly, 2013. 5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007 6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015
Web References:
1. https://www.tutorialspoint.com/python/index.htm 2. https://www.w3schools.com/python/ 3. https://www.javatpoint.com/python-tutorial 4. https://www.geeksforgeeks.org/python-programming-language/

NARAYANA ENGINEERING COLLEGE: GUDUR								
20EN1502	ORAL COMMUNICATION SKILLS LAB							
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
II	0	0	2	32	1	40	60	100

Task – 1: Introducing to others

Situational Dialogues, Ice - Breaking Activity, Introducing Oneself and Others – Greetings – Taking Leave, Think pair share, Oral Description of Pictures, Photographs, Products, and Process

Task – 2: Debate

What is Debate, How to Debate, Tips for Debate, Debate Practice, Explanation of Debate Techniques, Debate Videos Presentation

Task – 3: Group Discussion

What is Group Discussion, Types of Group Discussion, Tips and Techniques for Effective Group Discussion, Group Discussion Videos Presentation.

Task – 4: Professional Skills

Telephone Etiquette, Making an Appointment, Telephone Talk and Tips, Effective E-mail Resume Writing, Resume Cover Letter, Curriculum Vitae Preparation

Task – 5: Presentation Skills

Oral presentations (individual and group) through Seminars / PPTs, Importance of Body Language, Paper Presentation, Public Speaking Tips, Effective Presentation of renowned speakers.

Task – 6: Interview Skills

Interview Skills Introduction, Interview strategies, Interview questions, Successful Interview presentations and Mock Interviews.

Reference Books:

1. Rizvi, Ashraf. M., Effective Technical Communication, Mc Graw Hill, New Delhi. 2005
2. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi. 2011.
3. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
4. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill 2009
5. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009

NARAYANA ENGINEERING COLLEGE: GUDUR								
20MA1005	COMPLEX ANALYSIS & NUMERICAL METHODS							R-20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100
Pre-requisite: inter mathematics								
Course Objectives: This course aims to providing the knowledge for the student about on								
<ol style="list-style-type: none"> 1. Special functions and 2. Complex Variables Differentiation & Integration. 3. Various numerical methods for solving an algebraic and transcendental equations, 4. To interpolating the values through the polynomials, 5. To evaluation of integral values through the numerical methods 6. To solve ordinary differential equations through the numerical methods. 								
Course Outcomes: After successful completion of the course, the student will able to:								
CO 1	Apply the techniques of special functions in various engineering problems . (BL-3)							
CO 2	Identify the analyticity of complex functions to find the derivatives of complex functions. (BL-2)							
CO 3	Apply Cauchy's integral formula and Cauchy's integral theorem to evaluate improper integrals along contours. (BL-3)							
CO 4	Solve the Algebraic ,Transcendental Equations by using numerical methods & understand the concepts of Interpolation . (BL-3)							
CO 5	Solve the ordinary differential equations by using various numerical methods. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3												
CO2	3	3											1	
CO3	3	3											1	
CO4	3	3												
CO5	3	3											1	

1- Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	Special Functions	Hours:10
Introduction to special functions, Beta function- Definition of beta function and its properties (with proof), Other forms of Beta function (with proof), Gamma function- Definition of Gamma function and its properties (with proof), Relation between Beta and Gamma functions (with proof)		

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Understand Beta and Gamma functions and its relations. (L-3) 2. Explain the applications and the usefulness of these special functions. (L-2) 3. Use Beta & Gamma functions to evaluate different types of integral problems (L-1) 4. Apply the techniques of special functions in various engineering problems. (L-3) 		
MODULE -2	Complex variables – Differentiation	Hours:10
Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate-construction of analytic function by Milne -Thomson method.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand functions of Complex variable and its properties. (L-3) 2. Evaluate derivatives of complex functions. (L-5) 3. Understand the analyticity of complex functions. (L-3) 		
MODULE-3	Complex Variables – Integration	Hours:8
Line integral-Contour integration, Cauchy's integral theorem (without proof), Cauchy's Integral formula (without proof), zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals (around unit circle, semi-circle with		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the integration of complex functions. (L-3) 2. Apply Cauchy's integral theorem and Cauchy's integral formula. (L-3) 3. Understand singularities of complex functions. (L-3) 4. Evaluate improper integrals of complex functions using Residue theorem. (L-5) 		
MODULE-4	Solution of Algebraic, Transcendental Equations & Interpolation	Hours:10
Introduction-Bisection method, Regula-falsi method, Newton Raphson method, Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Solve an algebraic or transcendental equation using an appropriate numerical method. (L-3) 2. Understand the use of different operators in interpolation. (L-2) 3. Find interpolating polynomials using Newton's forward and backward formulae. (L-2) 4. Understand the theoretical and practical aspects of the use of numerical methods. (L-2) 		
MODULE-5	Numerical integration & Solution of ordinary differential equations	Hours:10
Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method- Runge-Kutta Method.		

At the end of the Module 5, students will be able to:	
1. Apply numerical differentiation and integration techniques to various engineering problems. (L-3)	
2. Understand the techniques of Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule and its applications (L-2)	
3. Work out numerical differentiation whenever and wherever routine methods are not (L-1)	
4. Apply Runge-kutta method in engineering problems (L-3)	
Total hours	48

Content beyond syllabus:

1. Central difference interpolation.
2. Iteration Methods.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Special Functions	CO1	https://youtu.be/Zp05KlxaRcY
2	Complex Variables Differentiation	CO2	https://youtu.be/t9xW7UaZwZ0 https://youtu.be/59u4PnalRCc
3	Complex Variables integration	CO3	https://youtu.be/OQQqbV32b78
4	Solution of Algebraic and Transcendental Equations	CO4	https://www.youtube.com/watch?v=apuEXUAntJo
5	Numerical Differentiation & Integration	CO5	https://www.youtube.com/watch?v=0rtaUUonwkU
6	Numerical solution of Ordinary differential equations	CO6	https://www.youtube.com/watch?v=QugqSa3GI-w

Text Book(s):

1. B.S. Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publishers, 2017.
2. Ramana B.V., "Higher Engineering Mathematics", McGraw Hill Publishers, 2017.
3. S.S. SASTRY, Introductory Methods of Numerical Analysis, 5/e, PHI learning private limited, 2012.

Reference Book(s):

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley.
2. Veerarajan T., "Engineering Mathematics", Tata McGraw-Hill.
3. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
4. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.

Online Resources/ Web References:

1. <http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks>.
2. <http://www.math.ust.hk/~machas/numerical-methods.pdf>
3. http://www.efunda.com/math/math_home/math.cfm
4. <http://www.ocw.mit.edu/resources/#Mathematics>
5. <http://www.sosmath.com>
6. <http://www.mathworld.wolfram.com>
7. https://global.oup.com/uk/orc/biosciences/maths/reed/01student/numerical_tutorials

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1010	DATA STRUCTURES							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	2	0	2	32	3	40	60	100
Pre-requisite: Knowledge of Mathematics, Computer Programming, Analytical & Logical Skills								
Course Objectives:								
<ol style="list-style-type: none"> 1. To explain efficient storage mechanisms of data for an easy access. 2. To design and implementation of various basic and advanced data structures. 3. To introduce various techniques for representation of the data in the real world. 4. To develop applications using data structures. 5. To pertain knowledge on improving the efficiency of algorithm by using suitable data structure. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Classify the Data Structures concepts in real time applications. (BL-2).							
CO 2	Demonstrate the concepts of stacks and queues for organizing data. (BL-3).							
CO 3	Demonstrate the concepts of Linked Lists in Linear Data Structures. (BL-3).							
CO 4	Interpret different ways of handling Trees and Graphs as non-linear Data Structures (BL-3).							
CO 5	Analyze different searching and sorting techniques for organizing data (BL-4).							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	2	2										2	
CO 2	1	3	3										2	
CO 3	1	3	3	1									1	
CO 4	1	3	2	1									1	
CO 5	2	3	3	1									2	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	Introduction to Data Structures	6H
Introduction: Overview of Data Structures, Implementation of Data Structures, Algorithm Specifications, Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Arrays: One-Dimensional, Multi-Dimensional, Pointer Arrays.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> 1. Understand the linear and non-linear data structures. (BL - 2) 2. Understand the time and space complexities of an algorithm. (BL - 2) 3. Illustrate representation of data using Arrays. (BL - 2) 		
MODULE -2	Stacks and Queues	7H

Stacks: Introduction, Representation of a Stack, Stack Operations, Applications of Stacks.		
Queues: Introduction, Representation of a Queue, Queue Operations, Circular Queue, Applications of Queues.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Explain stack ADT and its operations. (BL - 2) 2. Understand the expression evaluation using stacks. (BL - 2) 3. Implement various queue structures. (BL - 3) 		
MODULE-3	Linked Lists	6H
Introduction, Singly linked lists, Doubly Linked Lists, Circular Linked Lists, Linked Stacks and Queues, Applications of Linked Lists.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Understand basics concepts of linked lists. (BL - 2) 2. Illustrate various structures of linked lists. (BL - 2) 3. Understand the concept of dynamic memory management. (BL - 2) 		
MODULE-4	Trees & Graphs	6H
Trees: Introduction, Basic Terminologies, Definition and Concepts, Representation of Binary Tree, Operations on a Binary Tree, Binary Search Tree, Height Balanced Binary Tree.		
Graphs: Introduction, Graph Terminologies, Representation of Graphs, Graph Operations, Shortest Paths – Warshall’s, Floyd’s and Dijkstra’s algorithms, Topological Sorting.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concept of trees. (BL - 2) 2. Compare different tree structures. (BL - 2) 3. Explain the importance of Graphs for solving problems. (BL - 2) 4. Understand graph traversal methods. (BL - 2) 5. Implement algorithms to identify shortest path. (BL - 3) 		
MODULE-5	Sorting, Searching and Hash Tables	7H
Sorting: Introduction, Bubble Sort, Selection Sort, Quick Sort.		
Searching: Introduction, Basic Terminology, Linear Search and Binary Search Techniques		
Hash Table: Hashing Techniques, Collision Resolution Techniques, Closed Hashing, Open Hashing.		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Implement the sorting algorithms (BL - 3) 2. Select the appropriate sorting algorithm for a given application (BL - 3) 3. Understand the concept of Hash Table (BL - 2) 4. Explain searching techniques. (BL - 2) 		
Total hours:		32 hours

Content beyond syllabus:		
<ol style="list-style-type: none"> 1. Heap Sort, Insertion Sort, Merge Sort 2. Optimum Sorting Algorithms 		
Self-Study:		
Contents to promote self-Learning:		
SNO	Module	Reference
1	Introduction to Data Structures	https://www.youtube.com/watch?v=coxWfcz_slk&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=1 https://www.youtube.com/watch?v=qt6gnsxevZ0&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=5 https://www.youtube.com/watch?v=NIWEdScxU9k&list=PLrjkTql3jnm8

		ikiQIeIHrMYCaBfkBkfYR&index=7
2	Stacks and Queues	https://www.youtube.com/watch?v=o-B4qNnwujY&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=10 https://www.youtube.com/watch?v=UK8WaQYdcMo&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=12
3	Linked List	https://www.youtube.com/watch?v=hGxtTPPpqQs&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=22
4	Trees & Graphs	https://www.youtube.com/watch?v=e14hpagIr3U&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=26 https://www.youtube.com/watch?v=ZAU5IICQBlS&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=46
5	Sorting and Hash Tables	https://www.youtube.com/watch?v=TnU8COKcZs&list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR&index=52

Text Book(s):

1. D. Samanta, "Classic Data Structures", 2nd Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2008.

Reference Books:

1. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Careermonk Publications, 2016
2. Peter Bras, "Advanced Data Structures", Cambridge University Press, 2014.
3. RS Salaria, Data Structures, 3rd Edition, Khanna Publishing House, 2017.
4. Yashwant Kanetkar, Data Structures through C, 3rd Edition, BPB Publications, 2019.
5. RB Patel, Expert Data Structures with C, Khanna Publications, 2019.
6. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures A Pseudo code Approach with C, Second Edition, Cengage Learning.
7. Ananda Rao Akepogu, Radhika Raju Palagiri, Data Structures and Algorithms Using C++,

Online Resources / Web Resources:

1. <https://nptel.ac.in/courses/106/102/106102064/>
2. https://swayam.gov.in/nd2_cec19_cs04/preview
3. https://www.youtube.com/watch?v=0IAPZzGSbME&list=PLDN4rr148XKpZkf03iYF1-O29szjTrs_O
4. https://www.youtube.com/watch?v=AT14ICXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuL18LU
5. https://www.youtube.com/watch?v=Db9ZYbJONHc&list=PLVIQHNRLfIP_OxF1QJoGBwH_TnZszHR_j
6. https://www.youtube.com/watch?v=92S4zgXN17o&list=PL2_aWCzGMAwI3W_JlcBbtYTwiQSsOTa6P
7. <https://www.youtube.com/playlist?list=PLrpxgoIHbaCQPHa2LnGX0f-dCIH2MWIFS>
8. <https://www.youtube.com/playlist?list=PLrjkTql3jnm8ikiQIeIHrMYCaBfkBkfYR>
9. https://www.tutorialspoint.com/data_structures_algorithms/data_structures_basics.htm
<https://www.hackerrank.com/domains/data-structures>
<https://www.cs.usfca.edu/~galles/visualization/Algorithms.html>
10. <https://discuss.codechef.com/t/data-structures-and-algorithms/6599>
11. Algorithms Notes for Professionals book : <https://books.goalkicker.com/AlgorithmsBook/>

NARAYANA ENGINEERING COLLEGE:GUDUR														
20ES1012	ELECTRONIC DEVICES AND CIRCUITS							R20						
Semester	Hours / Week			Total hrs	Credit C	Max Marks								
	L	T	P			CIE	SEE	TOTAL						
III	3	0	0	48	3	40	60	100						
Pre-requisite: Semiconductor Physics.														
Course Objectives:														
<ol style="list-style-type: none"> To study the operation and characteristics of PN junction diode and special semiconductor devices.. To familiarize the design and analysis of rectifiers with filters. To describe the characteristics of BJT and its configurations. To analyze the biasing circuits of BJT. To study the characteristics of MOSFET. 														
Course Outcomes: After successful completion of the course, the student will be able to:														
CO 1	Illustrate the V-I characteristics of P-N junction Diode and special semiconductor devices. (BL-2)													
CO 2	Demonstrate the performance of rectifiers with and without filters. (BL-2)													
CO 3	Compare the operating characteristics of BJT (BL-3)													
CO 4	Analyze the BJT biasing techniques. (BL-4)													
CO 5	Interpret the characteristics of MOSFET. (BL-2)													
CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											3	
CO2	3	2	3										3	
CO3	3	2											3	
CO4	3	3	2										2	
CO5	3	1	1										3	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	SEMICONDUCTOR DIODE&SPECIAL SEMICONDUCTOR DEVICES	10 Hrs
<p>Semiconductor Diode: Principle and Structure of PN junction diode, Open circuited PN junction diode, Energy band diagram of PN diode, Diode current Equation, Volt-Ampere Characteristics, Temperature dependence of Volt-Ampere Characteristics, Diode capacitance.</p> <p>Special Semiconductor Devices: Principle of operation and Characteristics of Varactor diode, Tunnel Diode, Photo diode, LED, SCR</p> <p>At the end of the Module 1, student will be able to:</p> <ol style="list-style-type: none"> Define PN junction diode (BL-1) Explain the operation of PN junction diode for both forward and reverse bias. (BL-2) Explain the energy band diagram of PN junction diode (BL-2) 		

4. Interpret the effect of temperature on V-I characteristics of PN junction diode (BL-2)
5. Derive the expression for transition and diffusion capacitance (BL-2)
6. Explain V-I Characteristics of various special diodes. (BL-2)
7. Describe the principle of operation of thyristors. (BL-2)

MODULE -2	RECTIFIERS & FILTERS	10 Hrs
<p>Diode applications: P-N junction diode as a rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, rectifier parameters, Harmonic components in Rectifier Circuits. Clippers and Clampers (Qualitative Treatment only)</p> <p>Filters: Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters, bleeder resistor.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the operation of a bridge rectifier. (BL-2) 2. Analyze the performance of rectifiers with and without filters. (BL-4) 3. Design half wave and full wave rectifier circuits. (BL-4) 4. Differentiate various rectifier circuits in terms of their parameter metrics.(BL-2) 5. Explain the importance of bleeder resistor (BL-2) 		
MODULE-3	BIPOLAR JUNCTION TRANSISTOR	9 Hrs
<p>Bipolar junction Transistor :Construction, Principle of Operation, transistor current components , transistor configurations, Transistor h-parameter model, calculation of h-parameters from characteristics, transistor as a switch, transistor as an amplifier.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the current components and their relationships in BJT (BL-2) 2. Explain principle, operation and applications of BJT (BL-2) 3. Describe input and output Characteristics of BJT (BL-2) 4. Differentiate BJT configurations (CB,CC,CE) (BL-2) 		
MODULE-4	TRANSISTOR BIASING	10 Hrs
<p>Transistor Biasing: Need for biasing, operating point, load line analysis, Stabilization against variations in I_{CO}, V_{BE} and β, biasing and stabilization techniques: fixed bias, collector to base bias, voltage divider bias, bias compensation techniques, thermal runaway, heat sink and thermal stability.</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain principle, operation and applications of MOSFET (BL-2) 2. Describe the operation and characteristics of Depletion MOSFET. (BL-2) 3. Explain the operation and characteristics of Enhancement MOSFET. (BL-2) 4. Differentiate enhancement and depletion mode MOSFET. (BL-2) 		
MODULE-5	METAL OXIDE SEMICONDUCTOR FIELD-EFFECT TRANSISTOR	9 Hrs
<p>MOSFET: Construction of depletion mode and enhancement mode of NMOS and PMOS, Drain characteristics of MOSFET, Transfer Characteristics of MOSFET, MOSFET as aSwitch, CMOS Inverter and it's Characteristics.</p>		
<p>At the end of the Module 5, students will be able to:</p> <ol style="list-style-type: none"> 1. Define biasing and stabilization (BL-1) 2. Explain the importance of thermal stability (BL-2) 3. Analyze the stabilization techniques.(BL-4) 		

4. Differentiate compensation techniques. (BL-2)

Total hours: 48 Hours

Content beyond syllabus:

1. Multi vibrators-Mono stable, Bi stable & Astable multi vibrators,
2. signal conditioning circuits-input signal determination, amplification, filtering.

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Semiconductor diode & Special semiconductor devices	https://www.electronics-tutorials.ws/diode/diode_3.html https://www.electrical4u.com/tunnel-diode
2	Rectifiers and filters.	https://www.electricaltechnology.org/2019/01/what-is-rectifier-types-of-rectifiers-their-operation.html
3	Bipolar junction Transistor	https://www.electronics-tutorials.ws/transistor/tran_2.html
4	Transistor Biasing	https://www.tutorialspoint.com/amplifiers/methods_of_transistor_biasing.htm
5	Field effect transistors	https://www.electronics-tutorials.ws/transistor/tran_5.html

Text Book(s):

1. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.
2. L. Boylestad and Louis Nashelsky (2006), Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall
3. Electronic Devices and Circuits by Lal Kishore, BS Publications.

Reference Book(s):

1. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.
2. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj (2008), Electronic Devices and Circuits, 2nd edition, Tata McGraw Hill, New Delhi.
3. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd edition, McGraw-Hill (India), 2010.

Online Resources /Web References:

1. http://www.acadmix.com/eBooks_Download
2. <https://www.freebookcentre.net/Electronics/Electronic-Circuits-Books.html>
3. <https://nptel.iitm.ac.in/courses/108/108/108108122/>
4. <https://www.classcentral.com/course/swayam-microelectronics-devices-to-circuits-14198>
5. <https://www.khanacademy.org/science/electrical-engineering>
6. <http://afrotechmods.com/tutorials>
7. http://www.tutorialspoint.com/electronic_devices

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2001	DIGITAL LOGIC DESIGN							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on number system and algebra.								
Course Objectives:								
<ol style="list-style-type: none"> To study the basic concepts of number systems and binary codes. To minimize Boolean expressions using map and Q-M method. To design combinational and sequential circuits. To familiarize Registers & counters using Flip-Flops. To understand the concept of memory organization 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Use number systems, binary codes and Boolean algebra to implement digital circuits (BL-3)							
CO 2	Apply minimization techniques on Boolean expressions.(BL-3)							
CO 3	Design combinational circuits using logic gates. (BL-3)							
CO 4	Analyze synchronous sequential circuits.(BL-4)							
CO 5	Classify the memories and programmable logic devices. (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1										1	
CO2	3	3	3	1									1	
CO3	3	3	3	1									1	1
CO4	3	1	2	1									2	1
CO5	2	2											1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	NUMBER SYSTEMS & BOOLEAN ALGEBRA	10 h
Number Systems: Introduction, Number Systems, Number base conversions, 1's and 2's Complements, BCD code, Excess -3 codes, Gray code, ASCII code, Error Detection and Correction Codes. Boolean Algebra: Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, Logic gates, implementation of Boolean functions using logic gates At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> List number systems. (BL-1) Illustrate different code conversions. (BL-2) List Theorem's and properties of Boolean algebra (BL-1) Explain the functionality of logic gates(BL-2) 		
MODULE -2	SIMPLIFICATION OF BOOLEAN FUNCTIONS	10 h

Introduction, Karnaugh map simplification, Don't care conditions, Prime Implicants, Quine-McCluskey method Simplification, NAND & NOR Implementations, Two Level Implementations.

At the end of the Module 2, students will be able to:

1. Apply basic laws and De Morgan's theorems to simplify Boolean expressions(BL-3)
2. Explain map and Q-M method to minimize Boolean expressions. (BL-2)
3. Implement Boolean expression using universal gates. (BL-3)
4. Implement Boolean expression using two level methods. (BL-3)

MODULE-3	COMBINATIONAL CIRCUITS	9 h
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Introduction, Design Procedure, Adders, Sub tractor, Binary Adder-Sub tractor, BCD Adder, Binary Multiplier, Magnitude Comparator, Multiplexers, De-multiplexers, Decoders, Encoders and Code Converters.

At the end of the Module 3, students will be able to:

1. Design combinational logic circuits. (BL-3)
2. Implement Boolean expression using multiplexer. (BL-3)
3. Implement higher order MUX using lower order MUX.(BL-3)
4. Design code converters using gates. (BL-3)

MODULE-4	SEQUENTIAL CIRCUITS	10 h
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Introduction, Latches, Flip-flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-Flop conversions, Design of Synchronous Sequential Circuits: State Equations, State Table, State reduction, State assignment, State diagram , Mealy and Moore machine models, Registers, Shift Registers, Counters: Synchronous counters, Asynchronous counters & other counters.

At the end of the Module 4, students will be able to:

1. Describe behavior of latches & flip flops. (BL-2)
2. Analyze the flip-flop conversions(BL-3)
3. Analyze synchronous sequential circuits. (BL-3)
4. Explain the design procedure of sequential circuits(BL-2)
5. Design synchronous sequential circuits using state reduction & assignment process. (BL-3)

MODULE-5	MEMORY & PROGRAMMABLE LOGIC DEVICES	9 h
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Introduction, Random Access Memory, Types of RAM, Memory decoding, Read Only Memory, Types of ROM, Flash memory, Programmable Logic Devices (PLDs): Basic concepts, Programmable Read Only Memory (PROM), Programmable Array Logic (PAL) and Programmable Logic Array(PLA).

At the end of the Module 6, students will be able to:

1. Explain PROM, PAL and PLA. (BL-2)
2. Compare digital logic families. (BL-2)
3. Illustrate the characteristics of digital IC's . (BL-2)

Total hours:	48 hours
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Content beyond syllabus:

1. Representation of signed & unsigned binary numbers in digital computer
2. Binary subtraction operation using 1's and 2's complement methods in digital circuits

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Number systems	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2	Simplification of Boolean functions	https://www.electrical4u.com/simplifying-boolean-expression-using-k-map/ https://www.electronicshub.org/k-map-karnaugh-map
3	Combinational circuits	https://www.allaboutcircuits.com/textbook/digital/
4	Sequential Circuits	https://www.electronics-tutorials.ws/sequential/seq_1.html https://technobyte.org/counters-up-down-synchronous-asynchronous/
5	Programmable logic devices	https://www.tutorialspoint.com/digital_circuits/digital_circuits_programmable_logic_devices.htm

Text Book(s):

1. M. Morris Mano, M.D. Ciletti, "Digital Design", 5th edition, Pearson, 2018.
2. John F Wakely Digital Design Principles And Practices, Pearson Publication, Fourth edition
3. Anil K. Maini, "Digital Electronics: Principles, Devices and Applications", Willey, 2007

Reference Book(s):

1. Anand Kumar, Switching Theory and Logic Design, PHI, 2008
2. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. R. P. Jain, "Modern Digital Electronics", 4th edition, McGraw Hill Education (India Private Limited), 2012.

Online Resources / Web References:

1. <https://nptel.ac.in/courses/108/105/108105113/> (IIT- Kharagpur – digital Circuits)
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-004-computation-structures-spring-2017/c4/>
3. <https://nptel.ac.in/courses/106/105/106105185/> (IIT- Kharagpur – Switching Circuits and Logic Design)
4. https://www.researchgate.net/publication/264005171_Digital_Electronics
5. https://www.academia.edu/37445384/Anil_K._Maini_Digital_Electronics_Principles_01.04.16.pdf
6. https://intuitionke.weebly.com/uploads/1/1/8/2/118271274/digital_principles_switching_theory.pdf
7. <https://www.javatpoint.com/digital-electronics>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2002	NETWORK THEORY							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	3	0	0	45	3	40	60	100
Pre-requisite: Fundamental of Basic Electrical circuits								
Course Objectives:								
<ol style="list-style-type: none"> To understand frequency response in electrical circuits The capability to analyze the Low and High Pass filter. Evaluate the behaviour of networks for transient analysis of first order and second order. Analyze and synthesize networks using Laplace transforms. Different types of two-port network analysis using network parameters, with different types of connections. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Describe the Series resonance ,parallel resonance and analyze the locus diagrams of R,L,C(BL-2)							
CO 2	Analyze the DC transients of R,L,C (BL-4)							
CO 3	Analyze the AC transients of R,L,C (BL-4)							
CO 4	Derive Two port network parameters of Electrical circuits(BL-3)							
CO 5	Analyze the Filters and Network functions(BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1									1	1
CO2	3	2	2	2									1	1
CO3	3	2	2	2									1	1
CO4	3	3	2	2									1	1
CO5	3	3	2	2									1	1

COURSE CONTENT		
MODULE – 1	RESONANCE	9hrs
Introduction, Definition of quality factor Q of inductor and capacitor, Series resonance, Bandwidth of the series resonant circuits, Parallel resonance (or anti-resonance), Locus diagram for Series R-L, R-C, R-L-C and Parallel Combination with Variation of Parameters.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain the series and parallel resonance.(BL-2) Understand the effect of resonance on series and parallel resonance circuits.(BL-2) 		

3. Understand the concept of locus diagrams. (BL-2)		
MODULE -2	DC TRANSIENT ANALYSIS	9hrs
Transient Response of R-L, R-C, R-L-C Series and Parallel Circuits for D.C Excitation-Initial Conditions-Solution Method Using Differential Equations and Laplace Transforms, Response of R-L & R-C Networks to Pulse Excitation.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the transient phenomenon in DC excitations. (BL-2) 2. Explain Application of Laplace transform for solution of D.C transient circuits. (BL-2) 3. Compare the classical method and Laplace transform approach in sinusoidal excitations. (BL-2) 		
MODULE -3	AC TRANSIENT ANALYSIS	9hrs
Transient Response of R-L, R-C, R-L-C Series and Parallel Circuits for Sinusoidal Excitations-Initial Conditions-Solution Method Using Differential Equations and Laplace Transforms.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the transient phenomenon in AC excitations. (BL-2) 2. Understand AC transient analysis in electrical circuits to know the power system stability. (BL-2) 3. Develop knowledge on R-L, R-C and R-L-C circuit analysis in A.C. (BL-3) 		
MODULE -4	TWO PORT NETWORKS	9Hrs
Two Port Network Parameters: Impedance, Admittance, Transmission and Hybrid Parameters and their Relations, Reciprocity and Symmetry conditions, Concept of Transformed Network, Two Port Network Parameters Using Transformed Variables.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concept of two port network theory. (BL-2) 2. Verify the Reciprocity and Symmetry conditions for the given two port network. (BL-1) 3. Understand the concept of Transformed Network (BL-2) 		
MODULE-5	FILTERS & NETWORK FUNCTIONS	9HRS
Filters – Low Pass – High Pass and Band Pass – RC, RL filters– derived filters and composite filters design – Attenuators – Network functions for one port and two port networks, pole-zeros of network functions and network stability		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the types of filters. (BL-2) 2. Explain the parameters for the design of various filters. (BL-2) 3. Explain the poles and zeros of a given transfer function. (BL-2) 		
Total hours:		45 hours

Content beyond syllabus:		
<ol style="list-style-type: none"> 1. Scattering Matrix 2. Fourier method of waveform analysis 		
Self-Study:		
Contents to promote self-Learning:		
SNO	Topic	Reference
1	Resonance and locus diagram	https://www.youtube.com/watch?v=6mC0xkXsFdw

2	DC Transient analysis	https://www.youtube.com/watch?v=15d-gyoBxIQ
3	AC Transient analysis	https://www.youtube.com/watch?v=SPs5o7SzcOo
4	Two port network	https://nptel.ac.in/courses/108/102/108102042/
5	Filters & Network function	https://www.youtube.com/watch?v=u59IUA6uvjk

Text Book(s):

1. A Sudhakar and Shyam Mohan SP, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, New Delhi, 2015.
2. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015

Reference Book(s):

1. S.Sivanagaraju, G.Kishor & C.Srinivasa Rao, "Electrical Circuit Analysis", Cengage Learning, 1st Edition, 2010.
2. A. Chakrabarti : Circuit Theory (Analysis and Synthesis), Dhanpat Rai & Co
3. Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits Schaum's Outline Series", 6th Edition, Tata McGraw-Hill, 2014, New Delhi.

Online Resources / Web Reference:

1. <https://nptel.ac.in/courses/108/105/108105159/>
2. [https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-10\(GDR\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-10(GDR)(ET)%20((EE)NPTEL).pdf)
3. [https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-1\(TB\)\(ET\)%20\(\(EE\)NPTEL\).pdf](https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-1(TB)(ET)%20((EE)NPTEL).pdf)
4. https://en.wikibooks.org/wiki/Circuit_Theory
5. <https://nptel.ac.in/content/storage2/courses/117108107/Lecture%2022.pdf>
6. <https://nptel.ac.in/content/storage2/courses/108101091/Week%208%20Slides.pdf>
7. <http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm>
8. <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-2/>
9. <http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html>
10. <https://opencourses.emu.edu.tr/course/view.php?id=3>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20ES1515	ELECTRONIC DEVICES LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	0	0	3	36	1.5	40	60	100
Pre-requisite:Basic knowledge on semiconductor physics.								
Course Objectives:								
1. To Gain Knowledge on basic electronic devices.								
2. To Observe the characteristics of various electronic devices.								
3. To prepare students for designing various biasing circuits								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basic characteristics and applications of basic electronic devices. (BL-02)							
CO 2	Draw the characteristics of electronic devices by plotting graphs (BL-02)							
CO 3	Analyze the Characteristics of UJT, BJT, FET, and SCR (BL-04).							
CO 4	Design FET based amplifier circuits/BJT based amplifiers for the given specifications. (BL-03)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2						3	2		2	2	2
CO2	3	1	2						3	2		2	2	2
CO3	3	1	1						3	2		2	2	2
CO4	3	2	2						3	2		2	2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1: PN Junction Diode	
Objective: To Verify the Volt- Ampere characteristics of a PN junction diode and find static, dynamic and reverse resistances of the diode from the graphs.	CO1
Task-2:ZENER DIODE	
Objective: Todesign a Zener diode based voltage regulatoragainst variations of supply and load.	CO 2
Task-3: Half Wave Rectifier	
Objective: To design a half wave rectifier for the given specifications with and without filters and verify experimentally and draw suitable graphs.	CO 3
Task-4: FULL WAVE RECTIFIER	
Objective: To design a full wave rectifier for the given specifications with and without filters, and verify the given specifications experimentally. Vary the load and find ripple factor. And draw suitable graphs.	CO 3
Task-5:COMMON EMITTER CONFIGURATION	
Objective: ToVerify the input and output characteristics of BJT in Common Emitterconfiguration experimentally and find the required h – parametersfrom the graphs	CO 3
Task-6:Common Emitter Configuration	

Objective: To Verify the input and output characteristics of BJT Common Emitter configuration experimentally and find h – parameters from the graph	CO3
Task-7: Common Collector configuration	
Objective: To Verify the input and output characteristics of BJT Common Collector configuration experimentally and find h – parameters from the graph	CO3
Task-8: MOSFET Characteristics	
Objective: To Study and draw the Volt Ampere characteristics of MOSFET	CO 4
Task-9: MOSFET As Switch	
Objective: To Study the Switching characteristics.	CO 4
Task-10:LED Characteristics	
Objective: To Study the characteristics of LED	CO4

Additional Experiments	
Task-11: VOLTAGE- DIVIDER BIAS CIRCUIT USING BJT.	
Objective: To Design and analyse the voltage- divider bias/self bias circuit using BJT	CO 1
Task-12:CLIPPERS AND CLAMPER CIRCUITS	
Objective: ToVerify clipping and clamper circuits using PN junction diode and draw the suitable graphs	CO1
Virtual Labs:	
Virtual Labs Links:	
1. http://ee-iitb.vlabs.ac.in/ee-iitb/	

Text Book(s):
<ol style="list-style-type: none"> 1. Fundamentals of Electronic Devices and Circuits Lab Manual By David Bell 2. Electronics Lab Manual By Navas K. A 3. Fundamentals of Electronic Circuit Design, Getting Started: MultiSim Textbook Edition byDavid J. Comer, Donald T. Comer.
Reference Book(s):
<ol style="list-style-type: none"> 1. A Guide to Circuit Simulation and Analysis Using PSPICE by Paul W. Tuinenga 2. Ben G. Streetman, Sanjay Banerjee , Solid State Electronic Devices, Pearson Prentice Hall, 2006. 3. Robert T. Paynter, “Introductory Electronic Devices and Circuits”, Pearson Education, 7th Edition 4. Sedra A.S. and K.C. Smith, “Micro Electronic Circuits”, Oxford University Press, 5th Edition.
Web References:
<ol style="list-style-type: none"> 1. https://www.academia.edu/28016003/EDC by Lal kishore 2. https://www.academia.edu/9984476/Electronic_devices_and_circuit_theory_robert_boylestad_1

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2501	Digital Logic Design Lab							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	0	0	3	33	1.5	40	60	100
Pre-requisite: Electronic Circuits, Basic Electronics								
Course Objectives:								
<ol style="list-style-type: none"> 1. Students will learn and understand the Basics of digital electronics 2. Students are able to design basic logic circuits, 3. Able to design combinational circuits. 4. Able to design sequential circuits. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the truth table of various expressions and combinational circuits using logic gates. (BL-2)							
CO 2	Develop various combinational circuits such as adders, sub-tractors, comparators, multiplexers and de-multiplexers. (BL-3)							
CO 3	Construct flips-flops, counters and shift registers. (BL-3)							
CO 4	Simulate full adder and up/down counters. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3						2	2		2	2	3
CO2	2		3						3	2		2	2	2
CO3	3	3	3						2	2		2	2	3
CO4	3	2	3						3	2		2	2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT		CO
Task-1 : STUDY OF LOGIC GATES		
Objective: To verify the Truth Table verification of AND, OR, NOT, NAND, NOR, EX-OR & EX-NOR gates.		CO1
Task-2 : FULL ADDER & SUBTRACTOR		
Objective: To realize the Full Adder and Sub-tractor circuits using basic logic gates and to verify their truth tables.		CO 2
Task-3: 4-BIT PARALLEL ADDER/SUBTRACTOR USING IC 7483		
Objective: To perform the addition and subtraction of two 4-bit binary numbers.		CO 2
Task-4: 4:1 MULTIPLEXER USING GATES		
Objective : To realize the 4 to 1 Multiplexer using gates.		CO 2
Task-5 : REALIZATION OF 1:8 DEMUX USING IC 74138		
Objective: To study the function of de-multiplexer using IC 74138.		CO 2
Task-6 : REALIZATION OF CLOCKED SR & JK FLIP FLOP		
Objective: 1. To verify the Truth Table of clocked SR Flip Flop 2. To verify the Truth Table of JK Flip Flop		CO 3

Task-7 : REALIZATION OF SHIFT REGISTERS USING IC7474	
Objective : To implement different types of shift registers like Serial In Serial Out [SISO], Serial In Parallel Out [SIPO], Parallel In Parallel Out [PIPO] and Parallel In Serial Out [PISO] using D-flip flops and to verify their observation table.	CO 3
Task-8: RING COUNTER AND JOHNSON (TWISTED RING) COUNTER	
Objective : To design and set up four bit Johnson and ring counter using JK Flip-Flops.	CO 4
Task-9: REALIZATION OF MOD – N COUNTER USING 7490	
Objective : To realize a Modulo N-counter using 7490 and verify the expected truth table and display the output waveform for a square wave input of given frequency. (N–to be specified, N=9).	CO 4
Task-10: MAGNITUDE COMPARATOR	
Objective : To Design & Verify the 4-bit Magnitude Comparator using two 2-bit magnitude comparators.	CO 4
Additional Experiments	
Task-1: DESIGN AND IMPLEMENTATION OF SEQUENCE GENERATOR	
Objective : Design and testing of sequence generator using D flip flop	CO 2
Task-2: INTERFACING 7-SEGMENT DISPLAY SYSTEM WITH IC 7447 TO DISPLAY 0-9	
Objective : To interface 7-segment display with IC 7447 to display the decimal digits from 0 to 9.	CO 2
Virtual Labs: http://vlabs.iitb.ac.in/vlabs-dev/labs/digital-electronics/index.html	

<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. M. Morris Mano, M.D. Ciletti, “Digital Design”, 5th edition, Pearson, 2018. 2. R. P. Jain, "Modern Digital Electronics", 4th edition, McGraw Hill Education (India Private Limited), 2012. 3. Anand Kumar, Switching Theory and Logic Design, PHI,2008 <p>Reference Book(s):</p> <ol style="list-style-type: none"> 1. Digital Fundamentals, Thomas L. Floyd, Pearson Education, ISBN:9788131734483 2. Digital Principles and Applications, Malvino and Leach, TMH <p>Web References:</p> <ol style="list-style-type: none"> 1. http://www.vlab.co.in/ 2. http://www.asic-world.com/ 3. http://electrical4u.com/ 4. http://www.electronics-tutorials.ws

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2002	Network theory lab						R-20	
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
III	0	0	3	36	1.5	40	60	100
Pre-requisite: Basic concepts of electrical circuits								
Course Objectives:								
A. To understand the Series Resonance ,Parallel Resonance, B. To understand Locus Of RLC Circuits. C. To learn to compute and to analyze the DC Transients,AC Transients for RLC series parallel circuits D. To learn and apply the concept of Two port networks to the RLC networks E. To analyse the types of filters and design the filters for required conditions for a given system.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the concept of resonance and locus diagrams of R,L,C.(BL-2)							
CO 2	Analyze the transient response of AC and DC circuits.(BL-3)							
CO 3	Determine experimentally the two port network parameters and filters and verify their result.(BL-2)							

TASK-1 Transient response of RL and RC circuit

Objective:

To verify the Transient response of RL circuit and to find the time constant of RL and RC network.

TASK-2 Transient response of RLC series circuit

Objective:

To verify the Transient response of RLC series circuit

TASK -3 Transient response of RLC parallel circuit

Objective:

To verify the Transient response of RLC parallel circuit

TASK-4 Locus Diagrams of RL and RC Series Circuits

Objective:

To Plot the current locus diagrams for RL and RC circuits.

TASK-5 Frequency response of series resonance circuit with analysis and design

Objective:

To determine resonant frequency, band width and Q-factor for series RLC circuits.

TASK-6 Frequency response of parallel resonance circuit with analysis and design.

Objective:

To determine resonant frequency, bandwidth and Q-factor for parallel RLC circuits

TASK-7 Z and Y Parameters

Objective:

To calculate and verify 'Z' parameters and Y parameters of two-port network.

TASK-8 Transmission and Hybrid Parameters

Objective:

To calculate and verify 'ABCD' parameters and „h” parameters of two-port network

TASK -9 Design and frequency response of constant 'k' low pass & high pass filters

Objective:

To plot the frequency response of Low pass filter and High pass filter.

TASK-10 Design and frequency response of Band pass filter

Objective:

To study frequency response of Band pass filter

Additional Experiments:**PSPICE SIMULATION****TASK-11 Simulation of AC Circuits****Objective:**

To simulate a simple AC circuits using PSpice

TASK-12 DC Transient Response**Objective:**

To simulate a simple DC circuits using PSpice

Text Book(s):

1. A Sudhakar, Shyamohan S Palli, "Circuits & Networks", Tata Mc Graw- Hill, 4th Edition, 2010
2. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010.

Reference Book(s):

1. Willam Hayt, Jack E. Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", Tata Mc Graw-Hill, 8th Edition 2012
2. Rudra ratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1st Edition, 1999.

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		2					2	2			1	1
CO2	3	3		2					1	2			1	1
CO3	3	3	2	2	2				2	2			3	3
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2003	ANALOG ELECTRONICS							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on concepts of electronic devices.								
Course Objectives:								
<ol style="list-style-type: none"> To study the effect of negative feedback on amplifier characteristics. To design RC & LC oscillator circuits. To analyze amplifier frequency response at low and high frequencies. To study coupling schemes and multi stage amplifiers. To analyze the large signal amplifiers and tuned amplifiers. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the small signal amplifiers at low frequencies and high frequencies.(BL-4)							
CO 2	Illustrate the concepts of negative feedback amplifiers. (BL-2)							
CO 3	Illustrate the working principle of oscillators. (BL-2)							
CO 4	Analyze the parameters of multi stage amplifiers.(BL-4)							
CO 5	Interpret the concepts of Power amplifiers and Tuned amplifiers.(BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2										2	
CO2	3	3	2										2	
CO3	3	3	1										1	
CO4	3	3	2	2									1	2
CO5	3	2	1	2									2	3

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	SMALL SIGNAL LOW FREQUENCY & HIGH FREQUENCY ANALYSIS	11 Hrs
<p>Low Frequency Analysis: Transistor hybrid model, determination of h-parameters, conversion of h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis.</p> <p>High Frequency Analysis: Hybrid- π Common Emitter transistor model, Hybrid π conductance's, Hybrid π capacitances, Validity of hybrid π model, determination of high-frequency parameters in terms of low-frequency parameters, CE short circuit current gain, Current gain with resistive load.</p>		
<p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> Define Transistor hybrid model.(BL-1) Compare different transistor amplifiers. (BL-2) Explain the effect of coupling and emitter bypass capacitors. (BL-2) Explain the gain bandwidth product of amplifiers.(BL-2) 		

	5. Analyze the Emitter follower frequency response at high frequencies.(BL-4)	
	6. Analyze the hybrid π CE transistor model. (BL-4)	
MODULE -2	FEEDBACK AMPLIFIERS	9 Hrs
Feedback concept, types of feedback, classification, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis of feedback amplifiers, Determination of input & output impedance of different feedback amplifier, Method of Analysis of Feedback Amplifiers.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Define negative and positive feedback in amplifiers.(BL-1) 2. Explain the effect of negative feedback on amplifier characteristics.(BL-2) 3. Compare different feedback topologies. (BL-2) 		
MODULE-3	OSCILLATORS	9 Hrs
Oscillator principle, condition for oscillations, types of oscillators, Generalized analysis of LC Oscillators, Hartley oscillator & Colpitt's oscillator using BJT and FET with relevant analysis, Crystal oscillators, RC-phase shift oscillator & Wein bridge oscillator using BJT with relevant analysis, Frequency & amplitude stability of oscillators.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain condition for oscillations and types of oscillators.(BL-2) 2. Illustrate the operation of RC oscillators.(BL-2) 3. Explain the operation of LC oscillators.(BL-2) 4. Demonstrate the frequency and amplitude stability of oscillators(BL-2) 		
MODULE-4	MULTISTAGE AMPLIFIERS	10 Hrs
Classification of amplifiers, Methods of coupling, Generalized analysis of Cascaded amplifier, Analysis of two stage RC coupled amplifier with frequency response, Cascode amplifier, Emitter follower , Darlington pair amplifier, Differential amplifier using BJT.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the concept of cascading and coupling schemes(BL-2) 2. Analyze two stage RC coupled amplifier (BL-4) 3. Summarize the darlington amplifier parameters.(BL-2) 1. Explain differential amplifier with BJT. (BL-2) 		
MODULE-5	POWER AMPLIFIERS & TUNED AMPLIFIERS	9 Hrs
Power Amplifiers: Classification, Class A Power Amplifier, Distortion, Second harmonic Distortion, Class B Amplifier, Push- pull amplifier, Complementary Symmetry Class AB Amplifier, Class C Amplifier, Thermal stability and Heat sink.		
Tuned Amplifiers: Tuned Circuit, Q-Factor, Single tuned capacitive coupled amplifier, Effect of Cascading Single tuned amplifiers on Band width, Stability.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. List types of power amplifiers & compare the voltage and power amplifier.(BL-2) 2. Discuss heat sinks, thermal stability and distortions.(BL-1) 3. Explain the concept of tuned circuits. (BL-02) 4. Compare different tuned amplifiers. (BL-02) 5. Derive the expression for gain and bandwidth of a single tuned amplifier. (BL-02) 6. Describe the effect of cascading on bandwidth of tuned amplifiers. (BL-02) 		
Total hours:		48 Hours

Content beyond syllabus:

1. Power amplifiers using MOSFET-efficiency of MOSFET power amplifier.
2. Cascaded amplifier using FET-small signal analysis of cascade amplifier using FET.

Self-Study:

Contents to promote self-Learning:

SN O	Module	Reference
1	Small Signal Low Frequency & High Frequency Analysis	https://www.tutorialspoint.com/amplifiers/amplifiers_classification.htm https://www.tutorialspoint.com/amplifiers/amplifiers_classification.htm
2	Feedback Amplifiers	https://www.tutorialspoint.com/amplifiers/amplifiers_feedback.htm
3	Oscillators	https://www.tutorialspoint.com/sinusoidal_oscillators/sinusoidal_oscillators_introduction.htm
4	Multistage Amplifiers	https://www.tutorialspoint.com/amplifiers/multi_stage_transistor_amplifier.htm
5	Power Amplifiers & Tuned Amplifiers	https://www.tutorialspoint.com/amplifiers/classification_of_power_amplifiers.htm https://www.tutorialspoint.com/amplifiers/tuned_amplifiers.htm

Text Book(s):

1. J. Millman and C.C. Halkias, "Integrated Electronics", McGraw-Hill, 1972.
2. Donald A. Neaman, "Electronic Circuit Analysis and Design", McGraw Hill.
3. Electronic Circuit Analysis 4th Edition – by K. Lal Kishore , BS Publications.

Reference Book(s):

1. Robert T. Paynter, "Introductory Electronic Devices and Circuits", Pearson Education, 7th Edition
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory" Pearson/Prentice Hall, 9th Edition, 2006.
3. Sedra A.S. and K.C. Smith, "Micro Electronic Circuits", Oxford University Press, 5th Edition.
4. Salivahanan, N.Suresh Kumar, A. Vallavaraj, "Electronic Devices and Circuits", Tata McGraw Hill, Second Edition

Online Resources/ Web references:

1. [https://www.academia.edu/28016003/EDC by Lal kishore](https://www.academia.edu/28016003/EDC_by_Lal_kishore)
2. [https://www.academia.edu/9984476/Electronic devices and circuit theory robert boylestad 1](https://www.academia.edu/9984476/Electronic_devices_and_circuit_theory_robert_boylestad_1)
3. Donald A. Neaman, "Electronic Circuit Analysis and Design", McGraw Hill.
4. <https://nptel.ac.in/courses/122/106/122106025/>
5. https://www.tutorialspoint.com/semiconductor_devices/index.htm
6. <https://www.allaboutcircuits.com/textbook/semiconductors/>
7. <http://www.satishkashyap.com/>

NARAYANA ENGINEERING COLLEGE:GUDUR

CONTROL SYSTEMS								
20EC2004	CONTROL SYSTEMS						R20	
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	2	0	0	32	2	40	60	100
Pre-requisite: Basics concepts of Electrical Circuits& Basics of Laplace transform								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand the merits and demerits of open and closed loop control systems 2. To understand the step response of second order control systems 3. To plot Root locus for the given system transfer function 4. To understand the stability analysis from Bode plot, polar plots 5. To understand the merits of state space analysis over time domain analysis 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the differential equations for mechanical and electrical systems and obtain the transfer function from block diagrams, servo motors and signal flow graphs (BL - 3)							
CO 2	Analyze the time domain specifications, steady state errors and to learn time response analysis of first and second order systems(BL - 3)							
CO 3	Summarize the concepts Routh's stability and Root locus to find the stability of the system (BL - 2)							
CO 4	Summarize the frequency domain specifications from Bode, Polar, Nyquist plots and evaluate the frequency domain specifications(BL - 2)							
CO 5	Summarize the concept of state space analysis, controllability and Observability and to obtain the transfer function. (BL - 2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3											3
CO2	3	3	1											3
CO3	1	2	2										3	
CO4	1	1	3	1										3
CO5	1	3	3											3

1- Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO CONTROL SYSTEMS	8 hrs
Examples & Classification of control systems, merits and demerits of Open Loop and closed loop control systems, Effects of positive and negative feedback Mathematical modelling and transfer function of Electrical and Mechanical systems, Analogous systems. Control System Components: DC Servo motor, AC Servo motor , Synchro Transmitter & Receiver (2h) Block diagrams: Block diagram representation of control systems, Block Diagram Reduction Rules .(4h) Signal flow graph: Definitions, Reduction using Mason's gain formula.(3h)		
At the end of the Module 1, students will be able to:		

1. Identify the difference between open loop and closed loop systems (BL=3) 2. Understand the effect of feedback on system performance (BL=2) 3. Apply the block diagram reduction to simplify the given system (BL=3)		
MODULE-2	TIME RESPONSE ANALYSIS	7 hrs
Standard test signals, Time response of first order and second order un damped, under damped, critically damped and over damped systems, Time domain specifications. (6h) Error Analysis: Steady state Error, static error coefficient of type 0,1, 2 systems(3h)		
At the end of the Module 3, students will be able to: <ol style="list-style-type: none"> Understand the importance of basic test signals . (BL=2) Understand the Time response of second order system with different dampings . (BL=2) Find steady state error for the given system for any input signal. . (BL=1) 		
MODULE-3	STABILITY ANALYSIS	6 hrs
Stability: The concept of stability, Routh's stability criterion, limitations of Routh's stability.(4h) Root locus plot: The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci. (5h)		
At the end of the Module 4, students will be able to: <ol style="list-style-type: none"> Understand various stability issues (BL=2) Apply Routh's stability criteria to given system for stability assessment (BL=3) construct the Root locus plot for the given system (BL=3) 		
MODULE-4	FREQUENCY RESPONSE ANALYSIS	6 hrs
Introduction, Frequency domain specifications, Bode plot, polar plot, Transfer function from the Bode Diagram, Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots. (8h) Compensation Techniques: Lag, Lead, Lag-Lead Compensators.(3h)		
At the end of the Module 5, students will be able to: <ol style="list-style-type: none"> Understand various frequency domain specifications. (BL=2) Explain the Bode plot for the given system. (BL=2) Find the stability of given system from Bode plot and polar plot. (BL=1) 		
MODULE-5	STATE SPACE ANALYSIS	5 hrs
Introduction: Concepts of state, state variables and state model, derivation of state models from differential equations, Diagonalization. (5h) Solution of state equation: Solving the Time invariant state Equations, State Transition Matrix and its Properties. (2h) The concepts of controllability and observability. (2h)		
At the end of the Module 6, students will be able to: <ol style="list-style-type: none"> Understand the importance of state space analysis (BL=2) Find the state model for the given transfer function through various techniques. (BL=1) Examine the controllability and observability of the given state model. (BL=1) 		
Total hours:		32 hours

Content beyond syllabus:

- Introduction to P, PI and PID controllers.
- State space representation of Armature and Field controlled DC motor.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Open Loop and closed loop control systems	CO1	https://nptel.ac.in/courses/107/106/107106081/
2	Time response of second order system	CO2	https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm
3	Routh's stability criteria	CO3	https://nptel.ac.in/courses/107/106/107106081/
4	Frequency domain specifications	CO4	https://www.tutorialspoint.com/control_systems/control_systems_frequency_response_analysis.htm
5	Controllability and observability	CO5	https://www.tutorialspoint.com/control_systems/control_systems_state_space_analysis.htm

Text Book(s):

1. "Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers, 5th edition, 2007, Reprint 2012.

2. Control Systems by [A. Anand Kumar](#), PHI Learning pvt. Ltd., second edition

Reference Book(s):

1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons PTE Ltd, 2013

2. Modern Control Engineering, Katsuhiko Ogata, PEARSON, 1st Impression 2015.

3. Automatic Control Systems, Farid Golnaraghi and Benjamin. C. Kuo, WILEY, 9th Edition, 2010.

4. N C Jagan, "Control Systems", BS Publications, 1st Edition, 2007.

5. S Palani, "Control Systems Engineering", Tata McGraw-Hill Publications, 1st Edition, 2001.

6. N K Sinha, "Control Systems", New Age International Publishers, 1st Edition, 2002.

Online Resources/ Web References:

1. <http://www.ent.mrt.ac.lk/~rohan/teaching/EN5001/Reading/DORFCH1.pdf>

2. <https://drive.google.com/file/d/0B0CHtxo5u4TNWldoYXVnS3MxV0k/view>

3. <http://www.aoengr.com/SampleBook.pdf>

4. <https://www.accessengineeringlibrary.com/content/book/9781259643835>

5. <http://175.101.102.82/moodle/>

6. <https://nptel.ac.in/courses/107/106/107106081/>

7. https://www.youtube.com/watch?v=XYbrgwKP_6k

8. https://drive.google.com/file/d/0B2D2VI5_6vK1WUx5T29kME1xelk/view

9. https://www.youtube.com/watch?v=sUDoTw_Llbk

NARAYANA ENGINEERING COLLEGE :: GUDUR								
20EC2005	ELECTROMAGNETIC WAVES AND TRANSMISSION LINES							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100
Pre-requisite: Vector Calculus, Knowledge of Integration and differentiation.								
Course Objectives:								
<ol style="list-style-type: none"> To study different coordinate systems, Physical significance of Divergence, Curl and Gradient. To acquire knowledge on electric and magnetic fields in both static and dynamic domains. To understand wave concept with the help of Maxwell's equations. To Analyze reflection and refraction of EM waves and Electromagnetic wave propagation in different media. To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications. 								
Course Outcomes: After successful completion of the course, the student will able to :								
CO 1	Apply the Coulomb's law and Gauss law to different charge distributions.(BL-3)							
CO 2	Make use of Biot-Savart Law, Ampere's Circuit law to static current distributions.(BL-3)							
CO 3	Analyze the electric and magnetic fields.(BL-4)							
CO 4	Interpret the characteristics of EM Wave.(BL-2)							
CO 5	Illustrate the concepts of transmission lines.(BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2		2									1	
CO2	3	3		2									1	
CO3	3	2	2										2	
CO4	3	1	1										2	2
CO5	3	2	2										2	2
1- Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Electrostatics	13 Hrs
Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Electric dipole, Energy Density, Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Illustrative Problems.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Summarize basic laws of static electric field. (BL-2) Derive the Maxwell's equations for electrostatic fields. (BL-3) 		

<ol style="list-style-type: none"> 3. Solve problems applying laws of electrostatics. (BL-3) 5. Explain electric energy and potential (BL-2) 6. Define currents of conductors and dielectrics (BL-1) 7. Illustrate Poisson's and Laplace's Equations (BL-2) 8. Summarize types of capacitors (BL-2) 		
MODULE -2	Magneto statics	9 Hrs
<p>Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Magnetic torque and moment, Magnetic dipole, Inductances and Magnetic Energy, Illustrative Problems.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Summarize basic laws of static magnetic field. (BL-2) 2. Derive the Maxwell's equations for magnetic fields. (BL-3) 3. Solve problems applying laws of magneto statics. (BL-3) 		
MODULE-3	Maxwell's Equations for Time Varying Fields	6 Hrs
<p>Faraday's Law and Transformer e.m.f, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Forms and Word Statements. Boundary Conditions of Electromagnetic fields: Dielectric-Dielectric and Dielectric-Conductor Interfaces, Illustrative Problems.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Derive Maxwell's equations for time varying electromagnetic fields. (BL-3) 2. Apply the boundary conditions of EM fields at the interface of different media.(BL-3) 3. Solve problems on time varying maxwell's equations of electromagnetic fields. (BL-3) 		
MODULE-4	EM Wave Characteristics	12 Hrs
<p>Wave Equations ,Uniform Plane Waves – Definition, All Relations between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation, Polarization, Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Surface Impedance, Poynting Vector, and Poynting Theorem – Applications, Power Loss in a Plane Conductor, Illustrative Problems.</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Derive wave equations for different media. (BL-3) 2. Explain concept of polarization of electromagnetic waves. (BL-2) 3. Solve problems using wave characteristics equations (BL-3) 4. Explain principles of reflections and refraction for different incidences. (BL-2) 5. Explain concept of power flow using Pointing vector. (BL-2) 6. Solve problems on Brewster angle, power flow and surface impedance. (BL-3) 		
MODULE-5	Transmission Lines	8 Hrs
<p>Introduction, Transmission line parameters (Primary and Secondary), Transmission line equations, Input impedance, Standing wave ratio & power, Smith chart & its applications, Applications of transmission lines of various lengths, Micro-strip transmission lines – input impedance, Illustrative Problems.</p>		
<p>At the end of the Module 6, students will be able to:</p> <ol style="list-style-type: none"> 1.Study the principles of transmission lines and concept of smith chart.(BL-2) 2.Derive the input impedance of transmission line.(BL-3) 3. Calculate the line parameters through problem solving.(BL-3) 		

4. Study the applications of different lengths of transmission lines. (BL-2)

Total Hours: 48 Hours

Content beyond syllabus:

1. **Guided Waves:** Propagation of TE waves between parallel planes.
2. Propagation of TM waves between parallel planes.
3. Propagation of TEM waves between parallel planes.
4. Propagation of TEM waves between parallel planes.

Self-Study:

Contents to promote self-Learning:

S.NO	Module	Reference
1	Electrostatics	https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory
2	Magnetostatics	https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory
3	Maxwell's Equations for Time-varying fields	https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory
4	EM Wave Characteristics	https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory https://lecturenotes.in/subject/77/electromagnetic-theory-emt https://gradeup.co/electronics-communication/electromagnetic-theory
5	Transmission Lines	https://youtu.be/_VCIdXEK2I https://youtu.be/OAL1AnOif2c https://youtu.be/-LS8qhXTN9M

Text Book(s):

1. Matthew N.O. Sadiku, S.V.Kulkarni, "Elements of Electromagnetics", Oxford Univ. Press, 6th ed., 2015.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", TMH, 7th ed., 2006.

Reference Book(s):

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000
2. John D. Krauss, "Electromagnetics", 4th Edition, McGraw- Hill publication 1999.

Online Resources/ Web References:

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://nptel.ac.in/courses/115/101/115101005/>
3. <http://nptel.ac.in/courses/117101056/>
4. www.nptelvideos.in/2012/12/transmission-lines-and-em-waves.html
5. <https://www.khanacademy.org/>
6. https://www.tutorialspoint.com/electromagnetics_theory/index.asp
7. https://swayam.gov.in/nd1_noc19_ph08/preview
8. <http://www.a-zshiksha.com/forum/viewtopic.php?f=147&t=61578>
9. <https://freevideolectures.com/course/3288/electromagnetic-theory/7>
10. <https://www.youtube.com/watch?v=pGdr9WLto4A>
11. <https://youtu.be/6Nj2oqayIYc> (Polarization)
12. <https://youtu.be/-Kw-vy68CEA> (Oblique incidence of plane waves)
13. <https://youtu.be/fh2MLGVtb0U> (Power Loss in a Plane Conductor)
14. <https://www.tcyonline.com/tests/electromagnetic-theory>
15. <https://ocw.mit.edu/courses/physics/8-03sc-physics-iii-vibrations-and-waves-fall-2016/part-ii-electromagnetic-waves/lecture-12/>
16. www.dannex.se/theory/1.html
17. www.tandfonline.com/toc/uemg20/current
18. <https://youtu.be/qsXGBjXf8GA>

NARAYANA ENGINEERING COLLEGE: GUDUR								
20EC2006	PROBABILITY THEORY AND RANDOM PROCESS							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
IV	3	0	0	48	3	40	60	100
Pre-requisite:								
<ul style="list-style-type: none"> • Set theory • Integrations, differentiations, partial differentiations formulas • Terms involved in Electronics & Communications 								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand the basic probability concepts and to find the probability. 2. To acquire skills in handling situations involving more than one random variable and functions of random variables. 3. To analyze the concept of statistical averages. 4. To understand types of random processes, Auto-correlation, Cross Correlation and power spectral density and cross power spectral density 5. To understand the principles of random process relate to system concepts 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret the concepts of sample spaces and set theory to calculate probabilities (BL-2)							
CO 2	Apply the concept of random variables with probability density and distribution functions to compute probabilities for complex problems. (BL-3)							
CO 3	Compute the statistical averages for multiple random variables using joint probability density and distribution functions. (BL-2)							
CO 4	Interpret the concept of Power Spectrum Density & Cross Power Spectrum density related to temporal characteristics and spectral characteristics (BL-4)							
CO 5	Apply the principles of a random process for solving system related problems. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	2											
CO2	2	2	2											
CO3	2	3	2	3										
CO4	3	3	3	3									2	
CO5	3	2	2	3									2	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	PROBABILITY	9 Hrs
Probability introduced through Sets and Relative Frequency; Probability space & Axioms; Mathematical Model of Experiments, Joint probability, Conditional probability, Total probability and Baye's theorem		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the fundamental concepts of probability (BL-2) 2. Find the probability for real time examples (BL-1) 3. Find total probability (BL-1) 4. Apply Baye's theorem for different real time applications (BL-3) 		
MODULE -2	DISCRETE & CONTINUOUS RANDOM VARIABLES	9 Hrs
Probability mass function, probability distribution function, example random variables and distributions and density functions; Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random Variables; Central limit theorem (without+ proof)		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand probability distribution and density functions (BL-2) 2. Outline the importance of the central limit theorem (BL-2) 3. Solve the moments to the sum of random variables (BL-3) 4. Apply different probability distribution and density functions on random variables.(BL-3) 		
MODULE-3	OPERATIONS ON MULTIPLE RANDOM VARIABLES	9 Hrs
Expected value of a function of random variables, joint moments about the origin, joint central moments Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables. Markov, Chebyshev and Chernoff bounds.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the moments for multiple random variables. (BL-2) 2. Understand the concepts of linear transformation of Gaussian random variables. (BL-2) 3. Apply the different operations to multiple random variables. (BL-3) 		
MODULE-4	RANDOM PROCESSES: TEMPORAL CHARACTERISTICS & SPECTRAL CHARACTERISTICS	12 Hrs
The random process concept, classification of processes, concept of stationary and statistical independence. Correlation function.		
Power spectrum Properties, Relationship between power spectrum and autocorrelation function, properties of power spectral density, relation between cross – power density spectrum and cross correlation, properties of cross power spectral density; problems.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Define continuous and discrete-time random processes. (BL-1) 2. Explain various Stationary Processes. (BL-2) 3. Apply the concepts and its properties of auto correlation. (BL-3) 4. Apply the concepts and its properties cross correlation functions. (BL-3) 5. Understand the concepts of power spectral density & cross power spectral density (BL-2) 6. Apply PSD & CPSD properties on random process. (BL-3) 7. Apply CPSD properties on random process. (BL-3) 		
MODULE-5	RANDOM SIGNAL RESPONSE OF LINEAR SYSTEMS	9 Hrs

System Response – Convolution, Mean and Mean squared Value of System Response, autocorrelation Function of Response, Cross Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output, Band pass, Band Limited and Narrowband Processes, Properties.

Noise Definitions: White Noise, Ideal low passfiltered white noise, RC filtered white noise.

At the end of the Module 6, students will be able to:

1. Relate the theory of stochastic processes to analyze linear systems. (BL-2)
2. Understand the concepts of low pass and band pass noise models for random processes. (BL-2)
3. Apply the statistical characteristics to response of linear systems. (BL-3)
4. Analyse the output characteristics of a system when input is an WSS process. (BL-4)

Total hours: 48 Hours

Content beyond syllabus:

1. Discrete time markov process
2. Continuous time markov process

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	PROBABILITY	https://byjus.com/maths/probability/ https://www.britannica.com/science/probability-theory
2	Discrete & Continuous Random Variables	http://www.nptelvideos.com/lecture.php?id=10402
3	Operations on multiple random variables	https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470171455.a.p1 https://www.researchgate.net/publication/229766295_Autocorrelation_and_Cross-Correlation_Methods
4	Random Processes: Temporal Characteristics Random Processes – Spectral Characteristics	https://www.sciencedirect.com/topics/engineering/stationary-random-process https://www.cygres.com/OcnPageE/Glosry/SpecE.html https://faculty.washington.edu/dbp/PDFFILES/GHS-AP-Stat-talk.pdf
6	Random Signal Response of Linear Systems	https://www.projectrhea.org/rhea/index.php/ECE600_F13_Linear_Systems_with_Random_Inputs_mhossain https://faculty.kfupm.edu.sa/ee/muqaibel/Courses/E570%20Stochastic%20Processes/notes/RP/Linear%20Systems%20with%20Random%20Inputs.pdf

Reference Book(s):

1. R.P. Singh and S.D. Sapre, "Communication Systems Analog & Digital", TMH, 1995.
2. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing", Pearson Education, 3rd Edition.
3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", Oxford, 3rd Edition, 1999.
4. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age Publications, 2003.
5. B.P. Lathi, "Signals, Systems & Communications", B.S. Publications, 2003
6. keiser, gerd, "probability theory and stochastic processes", TMH publications, 4th Edition.

Online Resources/ Web References:**MODULE-1**

1. <http://www.nptelvideos.com/lecture.php?id=10375>
2. <http://www.nptelvideos.com/lecture.php?id=10376>
3. <http://www.nptelvideos.com/lecture.php?id=10378>
4. <http://www.nptelvideos.com/lecture.php?id=10379>

MODULE-2 &3

1. <http://www.nptelvideos.com/lecture.php?id=10386>
2. <http://www.nptelvideos.com/lecture.php?id=10387>
3. <http://www.nptelvideos.com/lecture.php?id=10388>
4. <http://www.nptelvideos.com/lecture.php?id=10389>
5. <http://www.nptelvideos.com/lecture.php?id=10390>
6. <http://www.nptelvideos.com/lecture.php?id=10402>

MODULE-4

1. <http://www.nptelvideos.com/lecture.php?id=10403>
2. <http://www.nptelvideos.com/lecture.php?id=10404>
3. <http://www.nptelvideos.com/lecture.php?id=10407>
4. <http://www.nptelvideos.com/lecture.php?id=10408>

MODULE-5

1. <http://www.nptelvideos.com/lecture.php?id=10406>
1. <https://www.tutorialspoint.com/probability/index.asp>
2. <https://byjus.com/maths/bayes-theorem/>
3. https://www.tutorialspoint.com/statistics/binomial_distribution.htm
4. https://web.sonoma.edu/eese/courses/es442/supp/correlation_applications.pdf
5. <https://www.jospt.org/doi/pdf/10.2519/jospt.2009.2969>

NARAYANA ENGINEERING COLLEGE: GUDUR								
20EC2007	Signals and Systems							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100
Pre-requisite:								
<ul style="list-style-type: none"> knowledge on Integration, Differentiations and Transforms 								
Course Objectives:								
<ul style="list-style-type: none"> To understand the mathematical description and representation of continuous and discrete-time signals and systems. To study the frequency representation of periodic signals. To characterize signals and systems using frequency domain methods. To study sampling theorem and to convert continuous-time signals to discrete-time signals with different techniques and vice-versa. To analyze continuous and discrete-time signals and systems using Laplace & Z- Transform mathematical tool. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret the concept of various signals and linear Time invariant Systems. (BL-2)							
CO 2	Interpret the concept of Fourier series for Continuous time signals.(BL-2)							
CO 3	Apply continuous time Fourier Transform for Continuous time signals .(BL-3)							
CO 4	Apply Sampling Theorem for Continuous time signals.(BL-3)							
CO 5	Analyze Laplace and Z-transform for continuous and discrete time systems.(BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										1	
CO2	3	3	3	2									3	2
CO3	3	3	2	2									2	1
CO4	3	2	3										2	
CO5	2	3	3	1									2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO SIGNALS AND SYSTEMS	9 Hrs
<p>SIGNALS AND SYSTEMS: Basic definitions and classification of Signals, Basic operations on signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time-Invariant Systems - Discrete-Time LTI Systems, Convolution Sum, Continuous-Time LTI Systems Convolution Integral, Properties of Linear Time-Invariant Systems.</p>		
<p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand classifications of the signals and systems. (BL-2) 2. Explain continuous and discrete time signals. (BL-2) 3. Understand the concept of convolution. (BL-2) 		
MODULE -2	FOURIER SERIES	8 Hrs
<p>Representation of Fourier series, Continuous time periodic signals, Dirichlet's conditions, Properties of CT Fourier Series, Trigonometric Fourier Series and Exponential Fourier Series with examples, Complex Fourier spectrum, Fourier series representation of a periodic signals.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Apply Fourier series for the periodic signals. (BL-3) 2. Solve problems by using Fourier series properties. (BL-3) 3. Sketch the complex Fourier spectrum. (BL-3) 		
MODULE-3	FOURIER TRANSFORMS	10 Hrs
<p>Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of CT Fourier Transform, Systems characterized by Linear constant coefficient differential equations. The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems. Definition, Computation and properties of DTFT for different types of signals and systems.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Analyze the periodic and aperiodic signals by applying Fourier transforms. (BL-4) 2. Interpret the Magnitude-Phase Representation of F.T & LTI Systems. (BL-2) 3. Solve problems by using F.T properties. (BL-3) 4. Analyze the spectral characteristics of signals using Fourier transform. (BL-4) 5. Analyze of DTFT for different types of signals and systems. (BL-4) 		
MODULE-4	SAMPLING	7 Hrs
<p>Representation of a Continuous Time Signal by its Samples - Sampling Theorem, Reconstruction of a Signal from its Samples Using Interpolation, types of sampling-natural sampling, flat-top sampling and impulse sampling, Effect of under sampling -Aliasing.</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Illustrate the representation of a Continuous Time Signal by sampling. (BL-2) 2. Understand the reconstruction of a sampled signal using Interpolation. (BL-2) 3. Compare different sampling techniques. (BL-2) 4. Solve problems for nyquist interval and nyquist rate. (BL-3) 		
MODULE-5	LAPLACE TRANSFORMS & Z-TRANSFORMS	14 Hrs
<p>Definition, Region of Convergence, Properties, Inverse Laplace Transform, Relationship between Fourier and Laplace Transforms, Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform .</p> <p>Definition, Region of Convergence, Properties of the z-Transform, Inverse z-Transform, Relation between Fourier and Z Transforms, Common z- Transform Pairs, Analysis and Characterization of LTI Systems Using z-Transforms.</p>		

At the end of the Module 4, students will be able to:

1. Understand the properties of Laplace transform. **(BL-2)**
2. Analyze the continuous-time and discrete-time signals and systems using Laplace transform. **(BL-4)**
3. Interpret the relationship between Fourier and Laplace Transforms. **(BL-2)**
4. Find the stability of the systems using ROC. **(BL-1)**
5. Understand the properties of Z - transform. **(BL-02)**
6. Analyze the discrete-time signals and systems using Z - transforms. **(BL-04)**
7. Interpret the relationship between Fourier and Z - Transforms. **(BL-02)**
8. Find the stability of the systems using ROC. **(BL-01)**

Total hours: 48 Hours

Content beyond syllabus:

1. Discrete Time Fourier transform
2. Discrete Fourier transform

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Introduction to Signals and Systems	https://nptel.ac.in/content/storage2/courses/117101055/downloads/Lec-10.pdf
2	Fourier series	http://jntuhsd.in/uploads/programmes/Module_7_Properties_of_Fourier_Series_and_Complex_Fourier_Spectrum.PDF
3	Fourier transforms	http://jpkc.gnuu.cn/jpkc/Signal/wangluokecheng/Content/6.2%20The%20MagnitudePhase%20Representation%20of%20the%20Frequency%20Response%20of%20LTI%20Systems.htm
4	Sampling	https://nptel.ac.in/content/storage2/courses/117101055/downloads/PS3.pdf
5	Laplace Transform & Z-Transforms	https://www.yumpu.com/en/document/read/22782683/chapter-4-analysis-and-characterization-of-lti-systems https://www.youtube.com/watch?v=8CRShpEn9tI

Text Book(s):

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, Wiley, 2005.
3. Signals and Systems, J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, TMH

Reference Book(s):

1. Simon Haykin and B. Van Veen, Signals & Systems, John Wiley, 2nd Edition, 2010.
2. A. Anand Kumar, Signals & Systems, PHI, 2011.
3. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2013.

Online Resources/ Web Resources:

1. <https://nptel.ac.in/courses/108/104/108104100/>
2. <https://nptel.ac.in/courses/117/104/117104074/#>
3. [https://eee.guc.edu.eg/Courses/Communications/COMM401%20Signal%20&%20System%20Theory/Alan%20V.%20Oppenheim,%20Alan%20S.%20Willsky,%20with%20S.%20Hamid-Signals%20and%20Systems-Prentice%20Hall%20\(1996\).pdf](https://eee.guc.edu.eg/Courses/Communications/COMM401%20Signal%20&%20System%20Theory/Alan%20V.%20Oppenheim,%20Alan%20S.%20Willsky,%20with%20S.%20Hamid-Signals%20and%20Systems-Prentice%20Hall%20(1996).pdf)
4. <https://books.google.co.in/books?id=MOVV94WUSIEC&printsec=frontcover#v=onepage&q&f=false>
5. https://www.tutorialspoint.com/signals_and_systems/index.htm
6. <https://www.wisdomjobs.com/e-university/signals-and-systems-tutorial-2419.html>
7. http://bonnie.ece.gatech.edu/book/worked_problems.html
8. https://pages.jh.edu/~bcooper8/sigma_files/courses/214/signalsandsystemsnotes.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2504	MATLAB AND SIMULINK LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	0	0	2	36	1	40	60	100
Pre-requisite: Knowledge on MATLAB Basics.								
Course Objectives:								
1. To provide practical exposure with generation and simulation of basic signals using standardized tools.								
2. To analyze signals and sequences using Fourier, Laplace and Z-transforms.								
3. To apply Matlab tools for writing programs.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate Operations on Matrices, Generation of Various signals and Sequences, Convolution and Correlation of signals and Sequences. (BL-2)							
CO 2	Analyze signals and sequences using MATLAB.							
CO 3	Apply different transforms on a given signal to draw magnitude and phase spectrum.							
CO 4	Identify whether the given system is linear or non-linear and time variant or invariant.							
CO 5	Verify sampling theorem using MATLAB.							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1							2				1	2
CO2	2	1							1				1	2
CO3	2	2	2	1					3				1	2
CO4	2	2	2	1					2				2	2
CO5	2								1				1	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1: INTRODUCTION TO MATLAB	
Objective: To familiarize MATLAB Tool.	CO1
Task-2: OPERATIONS ON MATRICES	
Objective: To write a MATLAB program to perform various mathematical operations on matrices. A. Addition of two N×N matrices B. Subtraction of two N×N matrices C. Multiplication of two N×N matrices D. Inverse of a matrix E. Eigen values of a matrix	CO 1
Task-3: GENERATION OF SIGNALS AND SEQUENCES	
Objective: To write a MATLAB program to generate various signals and Sequences such as unit Impulse, Unit Step, Square, Sawtooth, Triangular, Sinusoidal, Ramp, sinc function.	CO 1
Task-4: OPERATIONS ON SIGNALS AND SEQUENCES	

Objective: To write a MATLAB program to perform various operations on signals and sequences such as A. Addition B. Multiplication C. Scaling D. Shifting E. Folding	CO 2
Task-5: ENERGY AND POWER OF A SIGNAL	
Objective: To write a MATLAB program to find Energy and power of a given signal.	CO 1
Task-6: CONVOLUTION AND CORRELATION OF SIGNALS AND SEQUENCES	
Objective: To write a MATLAB program to perform convolution and correlation of given signals and sequences using MATLAB.	CO 1
Task-7: FOURIER TRANSFORM OF A SIGNAL	
Objective: To write a MATLAB program to find the Fourier Transform of a Signal and plot its Magnitude and Phase Spectrum.	CO 3
Task-8: VERIFICATION OF LINEARITY AND TIME INVARIANCE PROPERTIES	
Objective: To write a MATLAB program to verify Linearity and Time Invariance properties of Continuous/Discrete Systems.	CO 4
Task-9: LAPLACE TRANSFORM OF CONTINUOUS SIGNAL	
Objective: To write a MATLAB program to find the Laplace transform of a signal.	CO 3
Task-10: Z-TRANSFORM OF DISCRETE SIGNAL	
Objective: To write a MATLAB program to find the Z-transform of a discrete signal.	CO 3
Task-11: GAUSSIAN NOISE	
Objective: To write a MATLAB program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (pdf) and Power Spectral Density (PSD)	CO 1
Task-12: VERIFICATION OF SAMPLING THEOREM	
Objective: To write a MATLAB Program to verify Sampling theorem	CO 4

Additional Experiments:	
Task-13: LOCATING ZEROS AND POLES	
Objective: To write a MATLAB program to Locate Zeros and Poles and plot in S-Plane or Z-Plane for the given Transfer Function.	CO 3

Task-14: DETECTION OF NOISE BY CORRELATION	
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Objective: To write a MATLAB program to detect Noise by Auto Correlation / Cross correlation.	CO 1
Virtual Labs: <ol style="list-style-type: none"> 1.To represent discrete time signal and perform basic mathematical operations on DTS http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/signals/labs/exp1/index.php 2.Signals and their properties http://ssl-iitg.vlabs.ac.in/Signals%20and%20their%20properties(objectives).html 3.Fourier analysis of signals http://ssl-iitg.vlabs.ac.in/Signals_exp3(objectives).html 4.System and their property http://ssl-iitg.vlabs.ac.in/Exp_2_Signals%20and%20their%20property(objectives).html 5.Analysis of LTI system response http://ssl-iitg.vlabs.ac.in/Signals%20and%20their%20properties%205(objectives).html 6.Sampling and signal Reconstruction http://ssl-iitg.vlabs.ac.in/Sampling%20and%20signal%20reconstruction%20(objective).html 	

Text Book(s): <ol style="list-style-type: none"> 1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2ndEdition, PHI, 2009. 2.MATLAB for Beginners:A Gentle Approach,Petra Books,Peter I.Kattan, ISBN: 978-1438203096 3.Stormy Attaway, “Matlab: a Practical Introduction to Programming and Problem Solving”, Elsevier.
Reference Book(s): <ol style="list-style-type: none"> 1.Signals & Systems Using MATLAB Luis F. Chaparro and Aydin Akan,3rd Edition ,2019 2. Signals & Systems Using MATLAB Alan V. Oppenheim, Alan S. Willsky, MIT S. Hamid Nawab,2nd Edition ,1997 3. Simon Haykin and Van Veen, “Signals & Systems”, 2ndEdition, Wiley, 2005. 4. A. Anand Kumar, Signals & Systems, PHI, 2011. 5. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, 2nd Edition, 2013. 6.Signals and Systems, J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, TMH
Web References: <ol style="list-style-type: none"> 1..https://electrosome.com/signal-generation-in-matlab/ 2.https://electrosome.com/signal-operations-in-matlab/ 3.https://in.mathworks.com/help/signal/ug/linear-and-circular-convolution.html 4.https://in.mathworks.com/help/matlab/math/basic-spectral-analysis.html

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2503	ANALOG ELECTRONICS LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
IV	0	0	3	36	1.5	40	60	100
Pre-requisite: Basic knowledge on amplifiers and oscillators.								
Course Objectives:								
1. Analyze amplifiers for frequency response								
2. Analyze feedback circuits, amplifier circuits and oscillator circuits								
3. Design and construct simple electronic circuits to accomplish a specific function, e.g., designing amplifiers								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Measure various parameters of analog circuits and compare experimental results in the laboratory with theoretical analysis. (BL-3)							
CO 2	Analyze negative feedback amplifier circuits, oscillators, Power amplifiers, Tuned amplifiers. (BL-4)							
CO 3	Design analog electronic circuits using discrete components (BL-3)							
CO 4	Design RC and LC oscillators, Feedback amplifier for specified gain and multistage amplifiers for Low, Mid and high frequencies. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1				1					2	2				
CO2	3	2			2				2	2				2
CO3	3	2	2	2	2				2	2			2	2
CO4			2		2				2	2			2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1 : COMMON EMITTER AMPLIFIER	
Objective: Design voltage divider based Common Emitter amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response.	CO1
Task-2: RC COUPLED AMPLIFIER	
Objective: Design two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve.	CO 1
Task-3: DARLINGTON AMPLIFIER	
Objective: Design Darlington amplifier and determine gain and bandwidth from frequency response.	CO 2
Task-4: CASCODE AMPLIFIER	
Objective: Design cascode amplifier and determine gain and bandwidth from frequency response	
Task-5: VOLTAGE SERIES FEEDBACK AMPLIFIER	
Objective: Design voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier.	CO 2
Task-6 : CURRENT SHUNT FEEDBACK AMPLIFIER	

Objective: Design and simulate current shunt feedback using PSPICE/Multisim and determine the effect of feedback on the frequency response	CO 2
Task-9: RC PHASE SHIFT OSCILLATOR	
Objective: Design and simulate RC Phase shift oscillator for the given specification using PSPICE /Multisim. Determine the frequency of oscillation using simulation tool.	CO 2
Task-10 : HARTLEY OSCILLATOR	
Objective: Design and simulate Hartley oscillator using PSPICE /Multisim and determine the frequency of oscillations..	CO 2
Task-9: COLPITTS OSCILLATOR	
Objective: Design and simulate Colpitts oscillator using PSPICE /Multisim and determine the frequency of oscillations.	CO 4
Task-10: CLASS-A POWER AMPLIFIER	
Objective: Design and simulate class A power amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms.	CO 4
Task-11: CLASS-B PUSH PULL AMPLIFIER	
Objective: Design and simulate class B push-pull amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms.	CO 2
Task-12: SINGLE TUNED AMPLIFIER	
Objective: Design and simulate single tuned voltage amplifier using PSPICE /Multisim and determine the resonant frequency and bandwidth.	CO 2

Additional Experiments:	
Task-13: WEIN BRIDGE OSCILLATOR	
Objective: Design Wien bridge oscillator for the given specification. Determine the frequency of oscillation.	CO 3
Task-14 : CLASS C AMPLIFIER	
Objective: Design and simulate class C power amplifier using PSPICE /Multisim and find the efficiency and plot the output waveforms.	CO 3
Virtual Labs:	
<ol style="list-style-type: none"> http://vlabs.iitkgp.ac.in/tcad/exp10/index.html# http://vlab.amrita.edu/index.php?sub=1&brch=201 	

Text Book(s):
<ol style="list-style-type: none"> Introduction to PSPICE Using OrCAD for Circuits and Electronics by Rashid Muhammad H PSPICE and MATLAB for electronics: An integrated approach by John o. Attia Fundamentals of Electronic Circuit Design, Getting Started: MultiSim Textbook Edition by David J. Comer, Donald T. Comer.

Reference Book(s):

1. A Guide to Circuit Simulation and Analysis Using PSPICE by Paul W. Tuinenga
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory" Pearson/Prentice Hall, 9th Edition, 2006.
3. Sedra A.S. and K.C. Smith, "Micro Electronic Circuits", Oxford University Press, 5th Edition.

Web References:

1. <https://nptel.ac.in/courses/122/106/122106025/>
2. https://www.tutorialspoint.com/semiconductor_devices/index.htm
3. <https://www.allaboutcircuits.com/textbook/semiconductors/>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2008	ANALOG AND DIGITAL COMMUNICATION SYSTEMS						R20	
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisites:								
<ul style="list-style-type: none"> ✓ Electronic Devices ✓ Signals and Systems ✓ Probability and Random Processes 								
Course Objectives:								
<ol style="list-style-type: none"> 1. To familiarize various modulation and demodulation techniques of analog communication systems. 2. To acquire knowledge on angle modulation and demodulation techniques. 3. To learn the function of various stages of AM, FM transmitters. 4. To summarize various baseband and carrier modulation techniques 5. To understand the concept of information theory and channel coding. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the Analog modulation and demodulation systems BL4 domains.(BL:3)							
CO 2	Verify the effect of noise on the performance of communication system BL2							
CO 3	Analyze the various Digital modulation techniques BL4							
CO 4	Apply the Amplitude, frequency and phase shift keying techniques BL3							
CO 5	Make use of the different error control codes for efficient transmission BL3							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2										2	
CO2	3	3	3										1	
CO3	3	3	3										2	
CO4	3	3	2										1	
CO5	3	2	2										2	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	CONTINUOUS WAVE MODULATION	Hours:10
Introduction to communication systems, Need for modulation, Amplitude Modulation (AM): AM and its modifications – DSB, SSB, VSB, Frequency translation, Frequency Division Multiplexing (FDM).		
Angle Modulation: Frequency Modulation (FM), Phase modulation, Nonlinear Effects in FM, Super heterodyne receiver.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the benefits and applications of modulation.(BL:2) 		

	2. Describe the generation and detection of amplitude modulated signals.(BL:2)	
	3. Compare AM, DSB-SC, SSB-SC and VSB. (BL:2)	
MODULE -2	NOISE AND PULSE MODULATION	Hours:08
Introduction to noise: Types of noise, Receiver model, Noise in AM, DSB, SSB, and FM Receivers, Pre-emphasis and De-emphasis in FM.		
Introduction to pulse modulation: Sampling process, PAM, PWM and PPM-generation and detection.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1.List the types of noise. (BL:1) 2.Define noise temperature, noise bandwidth and noise figure.(BL:2) 3.List the types of pulse modulation schemes.(BL:2) 4.Analyze time and frequency domain representation of narrowband noise.(BL:4) 5.Compare PAM, PWM, PPM. (BL:2) 		
MODULE-3	SOURCE CODING SYSTEMS	Hours:10
Comparison of analog and digital communication systems, Elements of digital communication system, Sampler, Quantization-types and Encoder, PCM, Differential PCM, Delta Modulation (DM), Adaptive DM, Time Division Multiplexing (TDM), Comparison of the above systems.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Describe the elements of digital communications system. (BL:2) 2. Explain types of quantization techniques. (BL:2) 3. Differentiate PCM and DPCM. (BL:2) 4. Explain how different noises are eliminated in ADM?(BL:2) 5. Explain Time Division Multiplexing (TDM). (BL:4) 		
MODULE-4	BAND-PASS DATA TRANSMISSION	Hours:10
Introduction, Need for carrier modulation techniques, Binary shift keying: ASK, FSK, PSK, DPSK generation, Coherent and non coherent detection, Band width, Signal space diagram, Probability error calculation, M-ary shift keying: ASK, FSK, PSK, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK).		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the need for carrier modulation techniques. (BL:2) 2. Differentiate coherent and non-coherent detection. (BL:2) 3. Analyze carrier modulation techniques. (BL:4) 4. Explain Quadrature Amplitude Modulation. (BL:2) 		
MODULE-5	INFORMATION THEORY & CHANNEL CODING	Hours:10
Information theory: Message, Information, Entropy, Mutual information & its properties, Channel capacity, Shannon Hartley Theorem, Shannon Fano & Huff man coding and Illustrative problems.		
Channel Coding: Error detection & correction - Repetition & Parity check codes, Interleaving, Code vectors and Hamming distance, FEC and ARQ systems, Linear block codes – Matrix representation of block Codes, Convolutional codes, Viterbi decoding.		

At the end of the Module 5, students will be able to:

1. Define information. (BL:1)
2. Explain the types of entropies and its properties. (BL:2)
3. Discuss source coding theorem.(BL:2)Explain the concept of frequency interleaving. (BL:2)
4. Analyze channel coding techniques. (BL:4)

Term work:

- Design and simulate modulation and demodulation circuits using MATLAB Simulink.

Content beyond syllabus:

Advanced Communication Systems.

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	DSB-SC	CO1	https://www.youtube.com/watch?v=OC451cdFLoQ
2	Pre-emphasis and De-emphasis circuits	CO2	https://youtu.be/OUrp4unGeDg
3	Noise Analysis of SSB-SC	CO3	https://youtu.be/3dGEk5bzNoc
4	Time Division Multiplexing	CO4	https://www.youtube.com/watch?v=7JXkqSLc18g
5	Quadrature Amplitude Modulation	CO5	https://www.electronics-notes.com/articles/radio/modulation/quadrature-amplitude-modulation-what-is-qam-basics.php
6	Forward Error Correction (FEC) Systems	CO5	https://www.tutorialspoint.com/forward-error-correction-fec

Text Book(s):

1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2004.
2. B. P. Lathi, Zhi Ding "Modern Digital and Analog Communication Systems", Oxford press, 2011

Reference Book(s):

1. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley & Sons, 1999.
2. Bernard Sklar, F. J. Harris "Digital Communications: Fundamentals and Applications", Pearson Publications, 2020.
3. Taub and Schilling, "Principles of Communication Systems", Tata McGraw Hill, 2007

Online Resources:

1. <https://nptel.ac.in/courses/117/105/117105143/>
2. <https://nptel.ac.in/courses/117/101/117101051/>
3. <https://www.udemy.com/course/analog-communication/>
4. https://www.tutorialspoint.com/analog_communication/index.htm
5. <https://www.classcentral.com/course/swayam-analog-communication-13893>
6. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-450-principles-of-digital-communications-i-fall-2006/video-lectures/>
7. <https://nptel.ac.in/courses/117/101/117101051/>
8. <https://swayam.gov.in/NPTEL>
9. <https://nptel.ac.in/courses/117/105/117105143/>
<https://nptel.ac.in/courses/117/105/117105144/>

Web References:

1. <https://www.youtube.com/watch?v=S2vzyk6BXtA> (Square law modulator for AM Generation)
2. <https://www.youtube.com/watch?v=Q5dC9TbzR9k> (Phase Locked Loop)
3. <https://www.youtube.com/watch?v=zy4DIBYjnFM> (Frequency Division Multiplexing)
4. <https://www.youtube.com/watch?v=GzWVeiX9ohk> (Matched Filter)
5. <https://www.youtube.com/watch?v=ij760ICUfw> (QPSK)
6. <https://www.youtube.com/watch?v=dTPzZ3X-wLA> (Linear Block Codes)
7. https://www.tutorialspoint.com/analog_communication/analog_communication
8. <https://www.sciencedirect.com/topics/engineering/analog-communication>
9. <http://complextoreal.com/tutorials/>
10. https://www.tutorialspoint.com/digital_communication/digital_communication_digital_modulation_techniques.htm
11. <https://www.electronicdesign.com/technologies/communications/article/21798737/understanding-modern-digital-modulation-techniques>
12. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_noise.htm

NARAYANA ENGINEERING COLLEGE:GUDUR																				
20EC2009	Linear IC Applications							R20												
Semester	Hours / Week			Total hrs	Credit C	Max Marks														
	L	T	P			CI E	SEE	TOTAL												
V	3	0	0	48	3	40	60	100												
Pre-requisite: Basic knowledge of Electronic Devices, EDC and Digital Logic Design.																				
<table border="1"> <thead> <tr> <th>Module 1</th> <th>Module 2</th> <th>Module 3</th> <th>Module 4</th> <th>Module 5</th> <th>Total hours</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>09</td> <td>10</td> <td>09</td> <td>10</td> <td>48</td> </tr> </tbody> </table>						Module 1	Module 2	Module 3	Module 4	Module 5	Total hours	10	09	10	09	10	48	Course Objectives:		
Module 1	Module 2	Module 3	Module 4	Module 5	Total hours															
10	09	10	09	10	48															
<ol style="list-style-type: none"> 1. Explain the differential amplifier and its electrical parameters. 2. To introduce the basic building blocks of operational Amplifier. 3. To study and design various applications of OPAMPs. 4. To know the design of oscillators and Active filters using op amps. 5. To Study the concepts of the waveform generation, converters and introduce some special function Ics (i.e., IC 555 Timer, IC 565 PLL). 																				
Course Outcomes: After successful completion of the course, the student will be able to:																				
CO 1	Analyze the various characteristics of Differential amplifier.(BL: 4).																			
CO 2	Interpret the characteristics and configurations of Op-amp (BL: 2).																			
CO 3	Analyze the linear and nonlinear applications of an Op-amp (BL:2)																			
CO 4	Design the Oscillators and active filters using Op-amp (BL: 4).																			
CO 5	Study the applications of the special purpose integrated circuits and Data Convertors. (BL: 2).																			
CO-PO Mapping																				
CO	PO												PSO							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2						
CO1	3	3	3																	
CO2	3	3	2																	
CO3	3	3	3		1								1	1						
CO4	3	3	2		2								2	2						
CO5	3	3	2		2								2	1						
COURSE CONTENT																				
MODULE-1	Integrated Circuits and Differential Amplifier							10hours												
Introduction to IC, Classification of IC's, Differential amplifier, Differential Amplifier Circuits Configurations, DC and AC analysis of Dual input balanced/unbalanced and single input balanced/unbalanced output configurations, Properties of the differential Amplifier circuit configurations, Methods of improving CMRR - Constant Current Bias and Current mirror, Level Translator. (10 hrs)																				

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Infer the Dc and AC Analysis of BJT Differential Amplifier Configurations.(BL2) 2. Choose the Different methods to improve CMRR in Differential amplifier.(BL2) 3. Illustrate the use of level translator in differential amplifier.(BL2) 		
MODULE – 2	Operational amplifiers & OP-AMP Configurations	9hours
Introduction, Basic information of Op-Amp, Block diagram of an Op-Amp, Ideal and Practical Op-Amp Characteristic's, Ideal Equivalent Circuit of an Op-Amp, Ideal and Practical Voltage Transfer curve, DC and AC characteristics of Op-Amp.(5hrs).		
Introduction, feedback configurations, voltage series feedback, voltage shunt feedback and differential amplifiers, Frequency response, High frequency Op-Amp equivalent circuit, open loop gain Vs frequency, circuit stability, slew rate. (5hrs).		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Demonstrate the Op-Amp with negative and positive feedback.(BL2) 2. Outline the Gain Bandwidth Concept and the frequency response of the amplifiers. (BL2) 3. Illustrate various stages of operational amplifier(BL2) 4. Infer how to draw the ideal and practical Op-Amp Voltage Transfer Curve.(BL2) 5. Illustrate the DC and AC characteristics of an Op-Amp.(BL2) 		
MODULE -3	OP-AMP APPLICATIONS	10hours
DC and AC amplifiers, Summing Amplifiers, instrumentation amplifier, voltage to current converter, current to voltage converter, Integrator, Differentiator, Comparator, zero crossing detector, Schmitt Trigger, Square wave generator, triangular wave and Saw-tooth wave form generators.(10 hrs)		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Design Circuits using Operational Amplifiers for various applications.(BL3) 2. Illustrate the various types of Wave forms as sine wave, square, triangular and Saw-tooth wave forms.(BL2) 3. Summarize the linear IC applications helpful in IC Based Electronic Projects Design.(BL2) 		
MODULE-4	Oscillators & Active Filters	9hours
RC Phase shift and Weinbridge oscillators, Active filters: Classification of Filters, 1st and 2nd order LPF & HPF filters, Band pass, Band reject and All pass filters.(9 hrs)		
At the end of the Module 4, students will be able to		
<ol style="list-style-type: none"> 1. Demonstrate the basic operating principles of oscillator.(BL2) 2. Illustrate the various types of Filters. (BL2) 3. Explain First order Low Pass filter with Circuit diagram.(BL2) 		
MODULE-5	Specialized applications	10hours
555 timer IC (Mono-stable & Astable operation) & its applications, PLL, operating principles, Monolithic PLL, applications.(5 hrs)		
Introduction, Basic DAC techniques, Binary Weighted Resistor DAC, R-2R Ladder DAC, Inverted R-2R DAC, D/A Specifications, A/D Converters - Flash type, Successive Approximation type, Dual Slope type, A/D Specifications.(5 hrs)		
At the end of the Module 5, students will be able to:		
1. Demonstrate the operating principles of IC 555 timer, IC PLL and applications.(BL2)		

2.Explain the operating principle of PLL with block diagram(BL2)	
3.Summarize the Performance of the D to A and A to D converters.(BL2)	
4. Demonstrate the Switches for D/A converters. (BL2)	
5.Choose appropriate A/D and D/A converters for signal processing applications.(BL2)	
1: Low, 2-Medium, 3- High	

Term work:		
Construct circuits using different linear ICs and verify their outputs using simulation software.		
Content beyond syllabus:		
1. Introduction to TL082		
2. 723 Voltage regulator		
3 Fixed voltage regulators		
Self-Study:		
Contents to promote self-Learning:		
SNO	Topic	Reference
1	Integrated Circuits & Differential Amplifiers	<p>1. https://www.youtube.com/watch?v=bTsMRtfrK8&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=23&t=0s (Integrated Circuits)</p> <p>https://www.youtube.com/watch?v=8VUBnkUcUtE (Differential amplifiers)</p> <p>https://www.youtube.com/watch?v=QzeH0exPi-c&list=PLB9Enjz2xxTqsgE2Wwoqclj0iA2TV9QxZ&index=29 (DC Analysis of DIBO)</p> <p>https://www.youtube.com/watch?v=9Zp6Uk0YsIU&list=PLB9Enjz2xxTqsgE2Wwoqclj0iA2TV9QxZ&index=19M(DIBO-Gain)</p> <p>https://www.youtube.com/watch?v=B9PJJsK3mk (Current Mirror)</p> <p>https://www.youtube.com/watch?v=rxKXct8ZVM&list=PLB9Enjz2xxTqsgE2Wwoqclj0iA2TV9QxZ&index=18 (DIBO-Resistanc)</p>
2	Operational Amplifiers and Configurations	<p>1. https://www.youtube.com/watch?v=BixWPRNuH9M&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=1(Operational Amplifier)</p> <p>2. https://www.youtube.com/watch?v=jaD8VMjps4&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=9(Differential Amplifier)</p> <p>3. https://www.youtube.com/watch?v=elby2FWBkeE&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=8(DC Characteristics)</p> <p>4. https://www.youtube.com/watch?v=uVr0UaRppGY&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=7(AC Characteristics)</p> <p>5. https://www.youtube.com/watch?v=r11lwWyumu8&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=6(Voltage series feedback amplifier)</p> <p>6. https://www.youtube.com/watch?v=3Wd6sWIH2vU&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=5 (Voltage shunt feedback amplifier)</p>

		<p>7. https://www.youtube.com/playlist?list=PLm_MSCIsnwm91RcONokvGw2dRxG-s_nM- https://www.youtube.com/playlist?list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh</p>
3	Applications of Op-Amps	<p>1. https://www.youtube.com/watch?v=Pfn2aOnW8yo&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=4 (Instrumentation Amplifier) 2. https://www.youtube.com/watch?v=sz6OyNG2Nm0&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=11 (Operational Amplifier Applications & Filters) https://www.youtube.com/watch?v=4DgnGoGiYew&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=20 (Comparators) https://www.youtube.com/watch?v=PYEOTiU6qQg&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=16 (Sample & Hold, Schmitt Trigger) https://www.youtube.com/watch?v=J_rLtPiu7kl&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=17 (Multivibrators) https://www.youtube.com/playlist?list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh</p>
4	Oscillator & Active Filters.	<p>https://www.youtube.com/watch?v=M3yI0byaqKc&list=PL1hqL6v9rNq4tKIAW7p4vn26yRyu8XdfJ&index=28&t=0s (Introduction to Oscillator) https://www.youtube.com/watch?v=8eLoIUGSXns&list=PL1hqL6v9rNq4tKIAW7p4vn26yRyu8XdfJ&index=28 (Rc Phas shift Oscillator) https://www.youtube.com/watch?v=YH1zbPA_i2Y (Wein bridge Oscillator-NPTEL). https://www.youtube.com/watch?v=YZnd4IJBaOI&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=14 (First order Filters) https://www.youtube.com/watch?v=uj4b2O4XVVE&list=PL1hqL6v9rNq4tKIAW7p4vn26yRyu8XdfJ&index=26 (Band Pass and Band Reject Filters)</p>
5	Specialized Applications	<p>https://www.youtube.com/watch?v=CGj8YpEn9iU&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=10 (555 Timers) https://www.youtube.com/watch?v=CGj8YpEn9iU&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=10 (PLL & VCO) https://www.youtube.com/watch?v=-FPiAjbJmPI&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=21 (PLL Applications) https://www.youtube.com/playlist?list=PLm_MSCIsnwm91RcONokvGw2dRxG-s_nM- https://www.youtube.com/watch?v=86gPOMaZQCs&list=PLClvmlKio9stZC5Fvglq-Tr5Z_oMQZkh&index=19 (A/D and D/A Converters)</p>

Text Book(s):

1. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", 4th Edition, PHI, 2002
2. Choudhary D. Roy, Shail B. Jain, Linear Integrated Circuits, New Age International (p) Ltd, (2018-19 Session), 5th Edition (Paperback)

Reference Book(s):

1. Analog Electronics, L.K. Maheshwari, Laxmi Publications, PHI, 2005
2. D.A. Bell, Operational Amplifiers and Linear ICs. Oxford University Press, 3rd edition.
3. R.F. Coughlin & Fredrick Driscoll "Op-Amps & Linear Integrated Circuits" 6th Edition, PHI.
4. F. Sergio, Design with Op Amps & Analog Integrated Circuits. McGraw Hill, 1997
5. D. William, Operational Amplifiers with Linear Integrated Circuits. Prentice Hall, 2004
6. Analog Electronics, I.G. Nagrath, PHI 2nd edition (13 September 2013)
7. K. Lal Kishore, "Operational Amplifiers and Linear Integrated Circuits", Pearson Education India, 2009.

Online Resources:

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-20/-Op-Amps>
2. <https://www.youtube.com/watch?v=EGmreVQ-yNM-555> Timer
3. <https://www.youtube.com/watch?v=Q5dC9TbzR9k-PLL>
4. https://www.youtube.com/channel/UCsnMUwuYBQPFND6C_ybc9-g/videos
5. <https://www.youtube.com/watch?v=l6MkYKdkDkw-Integrated> Circuits
6. https://www.youtube.com/playlist?list=PLXMC-WkvZqjPnkYMaTtTf_JhFbPR2MQa-IC555-DAC-ADC
7. [https://www.youtube.com/playlist?list=PLnPkMfyANm0xpPD56ExVw8FEocT29wmIj-](https://www.youtube.com/playlist?list=PLnPkMfyANm0xpPD56ExVw8FEocT29wmIj-Integrated) Integrated Circuits and applications
8. <https://www.youtube.com/watch?v=BVJ7ri-vDh4-Digital> Logic Families
9. <https://www.youtube.com/watch?v=lxjauuQnWmE-Second> order Active filters
10. <https://www.youtube.com/playlist?list=PLnPUHuqVn2sddfG-BFFHe25ZBtS5PxTi6>
11. <https://www.youtube.com/watch?v=8VUBnkUcUtE-Differential> Amplifier DC and AC analysis
12. https://www.youtube.com/watch?v=QsxN1VWBXps&list=PLPHhJ2jrOrwxBOZrM4-xMxT3St2eYK3YY&index=2&t=0s_Linear Integrated Circuits
13. [https://www.youtube.com/playlist?list=PL4BY6TEAkoMvdIkr2NGLnuuGhctgosnQ-](https://www.youtube.com/playlist?list=PL4BY6TEAkoMvdIkr2NGLnuuGhctgosnQ-Linear) Linear Integrated Circuits

Web References:

1. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.htm
2. https://books.google.co.in/books/about/Linear_Integrated_Circuits.html?id=aByz-9D63wC
3. <https://nptel.ac.in/courses/117/107/117107094/>
4. <https://www.oreilly.com/library/view/linear-integrated-circuit9789332558250/>
5. <http://www.nptel.ac.in/courses/Webcourse-contents/IITROORKEE/Analog%20circuits/index.htm>
6. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/>

NARAYANA ENGINEERING COLLEGE: GUDUR								
20EC2010	MICROPROCESSORS AND MICROCONTROLLERS							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisite: Knowledge on switching theory and logic design, basics of computer organisation, architecture and basic programming techniques.								
Course Objectives:								
<ol style="list-style-type: none"> To study the internal architecture, interrupts & memory organization of 8086 microprocessor. To understand the programming concepts using 8086. To impart the basics of the MSP 430 and its variants. To understand programming techniques using interrupts, instruction set & addressing modes To provide the knowledge on low power modes of MSP 430. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the internal architecture, memory organisation and interrupt structure of 8086 microprocessor.(BL-2)							
CO 2	Construction of a maintainable assembly language program for an algorithm. (BL-3)							
CO 3	Interpret the concepts of low power modes of MSP 430.(BL-2)							
CO 4	Develop programs using software interrupts and addressing modes of MSP430.(BL-3)							
CO 5	Compare various on chip peripherals of MAP 430.(BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	2	1	3										1	1
CO3	3		2		2								2	1
CO4	2		2		1								1	1
CO5	2	1	2										1	1
1: Low, 2-Medium, 3- High														

-COURSE CONTENT		
MODULE – 1	8086 MICROPROCESSOR	10 h
Introduction, Microprocessor Evolution, Intel 8086 Microprocessor: Features block diagram, Register Organization, Memory organization, Interrupts and Interrupt Vector Table.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> List the features of 8086 microprocessor.(BL-1) Explain the architecture of 8086 microprocessor.(BL-2) Describe the memory organization of 8086 microprocessor.(BL-1) Explain the concept of interrupt handling of 8086.(BL-2) 		
MODULE 2	PROGRAMMING WITH 8086	10 h
Instruction Formats -Addressing Modes-Instruction Set of 8086, Assembler Directives, Macros and Procedures. Simple ALP's.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Explain the different addressing modes in 8086. (BL-2) Explain different instruction set of 8086 (BL-2) Implement ALPs using 8086 (BL-3) 		

MODULE-3	LOW POWER RISC MSP430	10 h
Low power RISC MSP430 block diagram, features and architecture, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Register set.		
At the end of the Module 3, students will be able to: <ol style="list-style-type: none"> 1. List the features of MSP 430 microcontroller.(BL-1) 2. Explain the architecture of MSP 430 microcontroller.(BL-2) 3. Compare variants of MSP 430. (BL-2) 		
MODULE-4	ADDRESSING MODES & INTERRUPTS OF MSP430	8 h
Addressing modes, Instruction set, Memory address space; I/O ports pull up/down resistors concepts, Interrupts and interrupt programming.		
At the end of the Module 4, students will be able to: <ol style="list-style-type: none"> 1. Apply data in MSP 430 programming using addressing modes. (BL-3) 2. Explain the instruction set of MSP 430. (BL-2) 3. Do programming using interrupts.(BL-3) 4. Lists interrupt types supported by MSP430. (BL-2) 		
MODULE-5	ON-CHIP PERIPHERALS OF MSP 430	10 h
On-chip peripherals (Analog & Digital), ADC, Comparator and data transfer using DMA controller, Watchdog timer, System clocks, Timers & Real Time Clock (RTC), Low power modes. Serial Communication Protocols: UART, USB, I2C & SPI and implementation using MSP430.		
At the end of the Module 5, students will be able to: <ol style="list-style-type: none"> 1. List the on chip peripherals of MSP 430 microcontroller.(BL-1) 2. Discuss MSP430 clock system. (BL-2) 3. Explain the operation of watchdog timer.(BL-2) 4. Explain the concept of Real Time Clock (RTC). (BL-2) 5. List the features of UART, USB, SPI, and I2C. (BL-1) 6. Explain the UART, I2C, SPI interface using MSP430. (BL-2) 		
Total hours:		48 Hours

Content Beyond syllabus:

1. ARM processor architecture: Features, Block diagram, pin diagram.
2. TIVA controller architecture: Features, Block diagram, pin diagram.

Self-Study:

Contents to promote self-Learning:

S.No	Module	Reference
1	8086 processor	https://electronicsdesk.com/8086-microprocessor.html https://circuitglobe.com/difference-between-8085-and-8086-microprocessor.html
2	Programming With 8086	http://www.ee.hacettepe.edu.tr/~alkar/ELE414/dirz2005/w6-414-[2005].pdf
3	Low Power RISC MSP 430	http://www.ece.utep.edu/courses/web3376/Notes_files/ee3376-isa.pdf
4	Addressing modes & interrupts of MSP430	https://cnx.org/contents/___autnt@1/Addressing-modes
5	On chip peripherals	http://learncontrollers.blogspot.com/2018/02/timer-of-msp430.html

		https://www.ti.com/lit/ml/slap117/slap117.pdf

Text Book(s):

1. “Microprocessor and Microcontrollers”, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publishers. Second Edition, 2016
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, I st Edition, 2008
3. “The X86 Microprocessors , Architecture, Programming and Inerfacing” , Lyla B.Das ,Pearson Publications,2010

Reference Book(s):

1. Advanced microprocessors & microcontrollers”, K M Burchandi & A K Ray, 3 rd edition, 2013
2. “Microprocessor and Interfacing: Programming and Hardware”, Douglas V.Hall, McGrawHill
3. “8086 microprocessor: Programming and Interfacing the PC”, Kenneth Ayala Cengage Learning.

Online Resources / Web References:

1. <https://nptel.ac.in/courses/108/103/108103157/>
2. <https://training.ti.com/msp430-ultra-low-power-microcontroller-overview>
3. <https://www.tutorialspoint.com/microprocessor/index.htm>
4. http://www.te.kmutnb.ac.th/~ptt/lectures/01_Microprocessors/03_MSP430/05_Tutorialv0_3.pdf

NARAYANA ENGINEERING COLLEGE:NELLORE		
	MICROPROCESSORS & MICROCONTROLLERS LAB	R2020
Pre-requisite: A course on Microprocessor and Microcontroller.		
Course Objectives:		
<ol style="list-style-type: none"> To acquire knowledge on CC studio & Launch pad. To acquire knowledge on MSP430 microcontroller instruction set. To synthesize embedded C programs using MSP430 microcontroller. 		
Course Outcomes: After successful completion of the course, the student will be able to:		
CO 1	Understand the installation process of CC studio & launch pad. (BL-2)	
CO 2	Synthesize operations on MSP430 microcontroller using Code Composer Studio. (BL-3)	
CO 3	Examine power consumption of microcontroller using low power modes. (BL-3)	

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	1	1	1		1						1	1	1	
CO 2		2	2		2							2		1
CO 3				2	2									1

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
TASK 1: INTRODUCTION TO CODE COMPOSER STUDIO TOOL	
Objective: Introduce the code composer studio to perform any task using Mixed signal Processor.	CO1
Task-2 : ARITHMETIC OPERATIONS	
Objective: Use Embedded C programming to perform arithmetic operations such as addition, subtraction.	CO 2
Task-3: LOGICAL OPERATIONS	
Objective: Use Embedded C programming to perform logical operations such as AND, OR, XOR operations.	CO 2
Task-4: DEMO ON MSP430 LAUNCH PAD	
Objective: Introduce the MSP430 launch pad to perform operations and interface devices.	CO 1
Task-5 : BLINKING LED USING GPIO	
Objective: To Interface and programme GPIO ports in C using MSP430	CO 2
<ol style="list-style-type: none"> Blinking LEDs(Red & Green) Push buttons 	
Task-6: USAGE OF LOW POWER MODES	
Objective: Usage of Low Power Modes: Use MSPEXP430FR5969 as hardware platform and demonstrate the low power modes and measure the active mode and standby mode current.	CO 3
Task-7: INTERRUPT PROGRAMMING THROUGH GPIOs	
Objective: To verify Interrupt programming of MSP 430 through GPIOs.	CO 3
Task-8: PWM GENERATION USING TIMER ON MSP430 GPIO	
Objective: To Generate Pulse Width Modulated signal using Timer on MSP430 GPIO.	CO 3
Task-9 : INTERFACING POTENTIOMETER WITH MSP430	

Objective: To Interface potentiometer with MSP430 to control the brightness of LED.	CO 3
Task-10: PWM BASED SPEED CONTROL OF DC MOTOR	
Objective: To control the speed of a DC motor by potentiometer connected to MSP430 GPIO	CO 3
Additional Experiments	
Task-1: Wi-Fi EMAIL APPLICATION	
Objective: To write an embedded C program for verifying the Wi-Fi e-mail application of MSP430 microcontroller by interfacing it with CC3100 Booster pack.	CO 2
Task-2: MASTER SLAVE CHARACTERISTICS	
Objective: To write an embedded C program for verifying the Master-slave characteristics of MSP430 microcontroller.	CO 3
Web References:	
<ol style="list-style-type: none"> 1. https://www.ti.com/tool/MSP-EXP430G2 2. https://youtu.be/V0GrBUbomDA 	

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2506	MICROPROCESSORS & MICROCONTROLLERS LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	0	0	3	36	1.5	40	60	100
Pre-requisite: Knowledge in C language								
Course Objectives:								
<ol style="list-style-type: none"> To gain knowledge on various tools for applying it to perform a specific task with microprocessors & microcontrollers. To prepare students for developing of real time embedded systems. To prepare students for project management. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Experiment with microprocessor to perform arithmetic, logical & string operations (BL-3)							
CO 2	Examine the hardware & software tools used by microcontroller. (BL-3)							
CO 3	Interface input and output devices with microcontroller. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2			2					1	1			1
CO2		2	2		2							2	1	1
CO3		2	2		2							2		1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
PART-A: 8086 Microprocessor Programs using MASM/8086 microprocessor kit.		
Task 1 : Arithmetic operations		
Objective: Use Assembly language programming to perform arithmetic operations such as		CO 1
<ol style="list-style-type: none"> Addition of N 16-bit numbers Subtraction of N 16-bit numbers 8-bit by 8-bit multiplication operation 16-bit by 16-bit multiplication operation Unsigned division operation Signed division operation 		
Task 2: Logical operations		
Objective: Use Assembly language programming to perform bit by bit logical operations such as		CO 1
<ol style="list-style-type: none"> AND, OR, NOT & XOR operations of two 8-bit numbers Shift & Rotate operations 		
Task 3: String operations		
Objective: Use Assembly language programming to perform various string operations such as		CO 1
<ol style="list-style-type: none"> Move a block of string byte Compare two strings 		

C. Reverse of a string D. Find length of a string	
Task 4 : Code Converters	
Objective: Use Assembly language programming to convert one form of binary code into another form such as A. BCD to ASCII code conversion B. Packed BCD to unpacked BCD	CO 1
PART-B: Embedded C Experiments using MSP430 Micro-controller	
Task 5 : Introduction to MSP430 launch pad and Programming Environment.	
Objective: Demonstrate MSP EXP430G2 launch pad & Code Composer Studio (CCS) to develop programs.	CO 2
Task 6 : Interfacing and programming GPIO ports	
Objective: Interfacing and programming GPIO ports in C using MSP430. 1. Blinking LEDs individually (Red / Green) 2. Blinking LEDs together (Red& Green) 3. Blinking LEDs alternately (Red& Green)	CO 3
Task 7: Read input from switch & glow LED	
Objective: Blink the onboard, GREEN / RED LED (connected to P1.0) whenever button (connected to P.1.1) is pressed and OFF when released using GPIO.	CO 3
Task 8: Configure Timer Block for Signal Generation	
Objective: Signal generation using interrupt programming technique.	CO 3
Task 9: Interrupt programming	
Objective: Interrupt programming examples through MSP430 GPIOs.	CO 3
Task 10: Interfacing potentiometer	
Objective: Interfacing potentiometer with MSP430 to check the operation based on applied resistance.	CO 3
Task 11: Configure Watchdog Timer In Watchdog Mode & Interval Mode	
Objective: Configure watchdog timer module in watchdog and Interval time mode and observe its output	CO 3
Additional Experiments:	
Task 12: PWM generation	
Objective: Pulse Width Modulated signal generation using timer on MSP430 GPIO.	CO 3
ADDITIONAL EXPERIMENTS	
Task 13: Programming with 8086 microprocessor	
Objective: Use assembly language programming to perform rotate operations with 8086 microprocessor.	CO 1
Task 14: Programming to find factorial of given number	
Objective: Use assembly language programming to find factorial of given 8-bit number using procedures with 8086 microprocessor.	CO1
Virtual Labs:	
<ol style="list-style-type: none"> 1. http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php 2. https://github.com/jishanshaikh4/Microprocessor-Virtual-Lab 3. http://www.msec.ac.in/pages/view/mpl 	

Self-Study:		
Contents to promote self-Learning:		
SN O	Topic	Reference
1	MASM	https://www.youtube.com/watch?v=m4Cxi8qhKd4
2	Assembly language programming with emulator 8086	https://www.youtube.com/watch?v=zEuvNYe7WG0
3	MSP430 launchpad	https://www.youtube.com/watch?v=V0GrBUbomDA

Text Book(s):

1. “Microprocessor and Microcontrollers”, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publishers. 1st Edition, 2010
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, Ist Edition, 2008
3. Advanced microprocessors & microcontrollers”, A K Ray, K M Burchandi 2nd edition.

Reference Book(s):

1. Introduction to Assembly Language Programming From 8086 to Pentium Processors by Dandamudi, Sivarama P.
2. “The X86 Microprocessors , Architecture, Programming and Inerfacing” , Lyla B.Das ,Pearson Publications,2010
3. “8086 microprocessor: Programming and Interfacing the PC”, Kenneth Ayala, Cengage Learning

Web References:

1. <https://www.geeksforgeeks.org/assembly-language-program-8086-microprocessor-divide-16-bit-number-8-bit-number/?ref=lbp>
2. <https://www.elprocus.com/8086-assembly-language-programs-explanation/>
3. https://processors.wiki.ti.com/images/5/52/03_-_MSP430_Programming.pdf
4. <https://www.accessengineeringlibrary.com/content/book/9780071830034/chapter/chapter6>
5. <http://209.211.220.205/vlabiitece/mi/labsMI.php>
6. <https://www.srmist.edu.in/content/microprocessor-lab-1>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2505	ANALOG AND DIGITAL COMMUNICATIONS LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	0	0	3	36	1.5	40	60	100
Pre-requisite: A course on Analog and Digital Communications.								
Course Objectives:								
<ol style="list-style-type: none"> To design and test communication circuits for analog modulation and demodulation schemes. To familiarize the concept of antenna parameters and their measurement process. To design and test digital modulation and demodulation techniques. To write and execute programs in MATLAB to implement various modulation techniques. To understand channel coding and equalization technique 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate analog & pulse modulation and demodulation schemes. [BL:3]							
CO 2	Analyze the behaviour of digital modulation and demodulation techniques. [BL:4]							
CO 3	Execute programs in MATLAB to implement various digital carrier keying techniques. [BL:3]							
CO 4	Simulate channel coding and equalization techniques using MATLAB [BL:2]							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2						2	2		2	3	3
CO2	3	3							2	2		2	3	3
CO3	3	3	2						2	2		2	3	3
CO4	3	3	2						2	2		2	2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
Task-1: AMPLITUDE MODULATION AND DEMODULATION		
Objective:	To study the function of Amplitude Modulation & Demodulation (under modulation, perfect modulation & over modulation) and also to calculate the modulation index.	CO 1
Task-2: FREQUENCY MODULATION AND DEMODULATION		
Objective:	To study the functioning of Frequency Modulation & Demodulation and to calculate the modulation index.	CO 1
Task-3: PULSE AMPLITUDE MODULATION & DEMODULATION		
Objective:	To Perform Pulse amplitude Modulation and Demodulation and to draw the observed waveforms.	CO 2
TASK-4: PULSE WIDTH AND POSITION MODULATION & DEMODULATION		

Objective: To implement the Pulse Width and Position Modulation & Demodulation circuits and to draw the observed waveforms.	CO 2
Task-5: PRE-EMPHASIS AND DE-EMPHASIS	
Objective: To study the functioning of Pre-Emphasis and De-Emphasis circuits.	CO 1
Task-6: PULSE CODE MODULATION AND DEMODULATION	
Objective: To Study & Understand the operation of the Pulse code modulation & Demodulation.	CO 2
Task-7: DIFFERENTIAL PULSE CODE MODULATION AND DEMODULATION	
Objective: To generate the differential Pulse code modulation & Demodulation using MATLAB	CO 2
Task-8: DELTA MODULATION AND DEMODULATION	
Objective: To transmit an analog message signal in its digital form and again reconstruct back the original analog message signal at receiver by using Delta modulator.	CO 2
Task-9: HUFFMAN CODING	
Objective: To generate Huffman coding using Matlab.	CO 3
Task -10: FSK MODULATION AND DEMODULATION	
Objective: To generate and demodulate frequency shift keyed (FSK) signal using MATLAB.	CO 3
Task-11: PSK MODULATION AND DEMODULATION	
Objective: To generate and demodulate phase shift keyed (PSK) signal using MATLAB	CO 3
Task-12: GENERATION OF QPSK USING MATLAB	
Objective: To generate and demodulate Quadrature phase shift keyed (QPSK) signal using MATLAB.	CO 3

Additional Experiments:	
Task-13: FREQUENCY DIVISION MULTIPLEXING USING MATLAB	
Objective: To study and simulate Frequency division multiplexing and draw its waveforms.	CO 4
TASK-14: CHANNEL EQUALIZATION ALGORITHM USING MATLAB	
Objective: To simulate the Zero Forcing Equalizer.	CO 4

Tools / Equipment Required:

- 1 Regulated Power Supply (0-30) V
2. CROs (0-20)MHz
3. Function Generators (0-3) MHz
4. RF Signal Generators (0-1000) MHz
5. Multimeters
6. Required Electronic components(active and passive)for the design of experiments from 1 -7
7. Radio Receiver Demo kits or Trainers.
8. RF power meter frequency range 0 – 1000MHz
9. Spectrum Analyzer
10. RPS - 0 – 30 V
11. CROs - 0 – 20 M Hz.
12. Function Generators - 0 – 1 M Hz
13. RF Generators (3 Nos.) 0 – 1000 M Hz.
14. Multimeters
15. Lab Experimental kit for Pulse Code Modulation (Experiment No.3 of part –A)
16. Required Electronic Components (Active and Passive) which include required ICs
17. Arbitrary Wave form generators/ PNS generators – 2 Nos. (to generate digital data at required data rates)
18. Licensed MATLAB software for 30 users with required tool boxes.

Virtual Labs:

<https://www.etti.unibw.de/labalive/index/analogmodulation/>

<http://vlab.amrita.edu/index.php?sub=59&brch=163>

<https://www.etti.unibw.de/labalive/index/digitalmodulation/>

<http://vlab.amrita.edu/index.php?sub=59&brch=163>

Self-Study:

Contents to promote self-Learning:

S.NO	Topic	CO	Reference
1	Amplitude modulation and demodulation	CO 1	https://youtu.be/cfwwxYvUYEg
2	Pre-emphasis and De-emphasis circuits	CO2	https://youtu.be/OUrp4unGeDg
3	Delta modulation and demodulation	CO 3	https://youtu.be/1BZrY7r5TRo
4	Digital keying techniques	CO4	https://www.youtube.com/watch?v=gmDBP-1QtiQ
5	Huffman coding using MATLAB	CO 5	https://youtu.be/uTdBFr8Fn-w

Text Book(s):

1. B. P. Lathi, “Modern Digital and Analog Communication Systems,” 3rd Edition, Oxford Univ. press, 2006.
2. John Wiley & Sons Simon Haykin, “Communication Systems,”3rd Edition, 2010.
3. Sham Shanmugam, “Digital and Analog Communication Systems”, Wiley-India edition, 2006.(edition)
4. R.P. Singh and S. Sapre, “Communication Systems: Analog and Digital”, 3rd edition, Tata McGraw-Hill, 2017.
5. J.S. Chitode, “Digital Communication:”, Technical Publications, Pune.

Reference Book(s):

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", 5th Edition, McGraw-Hill International Edition, 2010.
2. Herbert Taub & Donald L Schilling, "Principles of Communication Systems", 3rd Edition, Tata McGraw- Hill, 2009.
3. George Kennedy and Bernard Davis, "Electronics & Communication System", TMH, 2004.(edition).
4. Digital communications, 5/e,2008,J G Proakis, McGraw Hill, New delhi.
5. Digital communications, 2/e, 2007, Bernard Sklar,Pearson edition, New delhi.

Web References:

1. <https://www.youtube.com/watch?v=S2vzyk6BXtA> (Square law modulator for AM Generation)
2. <https://www.youtube.com/watch?v=Q5dC9TbzR9k> (Phase Locked Loop)
3. <https://www.youtube.com/watch?v=zy4DIBYjnFM> (Frequency Division Multiplexing)
4. <https://www.youtube.com/watch?v=ij760ICUfw> (QPSK)
5. <https://www.youtube.com/watch?v=dTPzZ3X-wLA> (Linear Block Codes)
6. https://www.tutorialspoint.com/analog_communication/analog_communication
7. <https://www.sciencedirect.com/topics/engineering/analog-communication>
8. <http://complextoreal.com/tutorials/>
9. https://www.tutorialspoint.com/digital_communication/digital_communication_digital_modulation_techniques.htm
10. <https://www.electronicdesign.com/technologies/communications/article/21798737/understanding-modern-digital-modulation-techniques>
https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_noise.htm

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2011	Digital Design using HDL							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100
Pre-requisite: Concepts of Switching Theory and Logic Design.								
Course Objectives:								
<ol style="list-style-type: none"> To describe, design, and simulate digital circuits using the Verilog Hardware description language. To understand behavioural and RTL modelling of digital circuits To verify timing constraints of digital circuits, through the Verilog HDL To synthesize, digital circuits designs on a development board To Implement digital circuits on a development board 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret digital design flow used in chip design Flow. (BL-2)							
CO 2	Model simple digital circuits using Verilog HDL. (BL-3)							
CO 3	Simulate digital circuits using Verilog HDL.(BL-3)							
CO 4	Analyze simulation techniques in behavioral and Switch level models of digital circuits. (BL-3)							
CO 5	Model digital circuits using Verilog tasks and directives.(BL-3)							

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2		3								2	2
CO2	3	3	1		3								2	1
CO3	3	3	1		3								2	2
CO4	3	3	1		3								3	1
CO5	3	3	3		3								3	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE -1	Introduction to digital design	10hrs
INTRODUCTION TO DIGITAL DESIGN. Introduction to hardware descriptive language (HDL). Difference between computer programming languages and HDLs Examples and HDL based digital design flow based on FPGA and CPL Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis using EDA tools At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> What is importance of HDL (Hardware Descriptive Language) (BL-2) Describe difference between concurrent and sequential programming (BL-2) Explain Digital design and implementation flow (BL-2) 		
MODULE -2	Introduction To Verilog	9hrs

<p>Language Constructs And Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.</p> <p>Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain simulation and synthesis models of Digital circuits (BL-2) 2. Describe simulation techniques(BL-2) 3. Explain How to create test bench (BL-2) 4. Model digital circuits in Gate level using Verilog (BL-3) 5. Explain Gate Primitives used in Verilog (BL-2) 		
MODULE-3	Verilog Modeling -1	10hrs
<p>Data Flow Level Modeling: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.</p> <p>Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow. <i>if</i> and <i>if-else</i> constructs, <i>assign-deassign</i> construct, <i>repeat</i> construct, <i>for</i> loop, the <i>disable</i> construct, <i>while</i> loop, <i>forever</i> loop, <i>parallel</i> blocks, <i>force-release</i> construct, <i>Event</i>.(6h)</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Model digital circuits in data flow style (BL-3) 2. Explain High level abstraction of digital systems with behavioral modeling of systems(BL-2) 3. Apply concepts behavioral constructs like ‘always’, ‘initial’, ‘if’, ‘if-else’, ‘case’..etc to describe a digital system (BL-3) 		
MODULE-4	Verilog Modeling -2	8hrs
<p>Switch Level Modeling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Tri-reg Nets.</p> <p>Functions, Tasks, And User-Defined Primitives: Introduction, Function, Tasks, User- Defined Primitives (UDP), FSM Design (Moore and Mealy Machines).(4h)</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Describe low level abstraction of digital systems with switch modeling of systems (BL-2) 2. Explain Switch level primitives (BL-2) 3. Describe the importance of tasks and functions (BL-2) 4. model digital systems using User- Defined Primitives (UDP) (BL-3) 		
MODULE-5	Tasks and Functions	11hrs
<p>System Tasks, Functions And Compiler Directives: Introduction, Parameters, Path Delays, Module Parameters, System Tasks and Functions, File-Based Tasks and Functions, Compiler Directives, Hierarchical Access, Verilog models for memories and buses:Static RAM memory, UART Design</p>		

At the end of the Module 5, students will be able to:

1. Explain the concept of FSM (BL-2)
2. Learn compiler directives. (BL-2)
3. Describe the usage of functions and tasks in packages(BL-2)

Total hours: 48 hours

Term work:

1. Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work
2. Design and implement digital circuit that Controlling LEDs with Switches using FPGA.

Content beyond syllabus:

1. Vertex FPGA structure

Self-Study:

Contents to promote self-Learning:

SN O	Topic	Reference
1	Introduction To Digital Design	http://vlsibyjim.blogspot.com/2015/03/vlsi-design-flow.html https://www.tutorialspoint.com/vlsi_design/vlsi_designdigital_system.htm https://www.youtube.com/watch?v=Abld-fSxjNM
2	Introduction To Verilog	https://freevidelectures.com/course/3696/advanced-vlsi-design/23 https://www.youtube.com/watch?v=bapXMc48Ma4&feature=youtu.be https://bt.nitk.ac.in/c/19b/cs201/index.html https://nptel.ac.in/courses/117/106/117106092/
3	Gate Level And Data Flow Level Modeling	https://www.chipverify.com/verilog/verilog-gate-level-examples https://technobyte.org/gate-level-modeling-in-Verilog/ https://www.youtube.com/watch?v=aGcLzYzxTKI https://technobyte.org/dataflow-modeling-verilog/ https://www.youtube.com/watch?v=W2XH-KtO930
4	Behavioral And Switch Level Modeling:	https://technobyte.org/behavioral-modeling-verilog/ https://www.youtube.com/watch?v=QzhFeDVehpY https://www.chipverify.com/verilog/verilog-switch-level-modeling https://www.youtube.com/watch?v=vwAhcO0q314
5	Functions, Tasks Compiler Directives	http://www.asicguru.com/verilog/tutorial/system-tasks-and-functions/68/ http://www.verilog.renerta.com/source/vrg00008.htm https://www.youtube.com/watch?v=a3qvwHeNEQw

6	Memory, Implementation Of Digital Circuits	https://alchitry.com/blogs/tutorials/how-does-an-fpga-work https://www.realdigital.org/doc/e3f19ac552a3f11020a8db62c525b2c4	
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Text Book(s):

1. T.R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL", WSE, IEEE Press 2008.
2. J. Bhaskar, "A Verilog Primer", BSP, 2nd edition 2003.
3. Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition, 2003.

Reference Book(s):

1. Thomas and Moorby, "The Verilog Hardware Description Language", kluwer academic publishers, 5th edition, 2002.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Logic Design with Verilog", TMH publications, 2007.
3. Charles.H.Roth,Jr., Lizy Kurian John "Digital System Design using VHDL" , Thomson, 2nd Edition, 2008

Online Resources:

1. www.xilinx.com, Xilinx project navigator evaluation tools version.
2. www.altera.com, Altera Quartus evaluation software tool

Web References:

1. <https://nptel.ac.in/courses/106/105/106105165/>(Hardware modeling using Verilog, IIT Kharagpur)
2. <https://nptel.ac.in/courses/106/105/106105083/>(Electronic Design Automation, IIT Kharagpur)
3. <https://nptel.ac.in/courses/117/106/117106092/> (VLSI Circuits , IIT Madras)

NARAYANA ENGINEERING COLLEGE::GUDUR								
20EC2012	Digital Signal Processing							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VI	3	0	0	48	3	40	60	100
Pre-requisite: Signal and systems								
Course Objectives:								
<ul style="list-style-type: none"> To illustrate the concepts of digital signal processing techniques. To analyze discrete time signals by FFT Algorithms. To design infinite impulse response filters for filtering undesired signals. To design finite impulse response filters for filtering undesired signals. To summarize the architectural features of programmable DSP Processor. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Illustrate the concepts of digital signal processing techniques. (BL-02)							
CO 2	Analyze time and frequency domains description of discrete time signals using FFT Algorithms (BL-03)							
CO 3	Design of IIR filters using different methods (BL-04)							
CO 4	Design of FIR filters using different methods (BL-04)							
CO 5	Summarize the architectural features of programmable DSP Processor. (BL-02)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	1									2
CO2	3	3	3	3	2									3
CO3	3	3	3	3										
CO4	3	3	3	3	2									3
CO5	3	3	2	2	2								2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO DSP AND DFT	11 Hrs
Review of DSP & Z-Transforms, Properties of DFT, DFT as a linear transformation, DFT relationship with other transforms, multiplication of two DFTs- the circular convolution, Linear filtering methods based on DFT-overlap-save and overlap-add methods. (7 Hr's)		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Classify Discrete-time signals and systems. (BL-02) Understand the representation of discrete time signals. (BL-02) Find the DFT for the given sequence. (BL-01) Compare overlap-save and overlap-add methods. (BL-02) 		

MODULE -2	FAST FOURIER TRANSFORM	08 Hrs
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Efficient computation of DFT algorithms - Radix 2-Decimation-in-Time & Decimation-in-Frequency algorithms, Inverse FFT, Illustration with an example (8 Hr's)

At the end of the Module 2, students will be able to:

1. Understand FFT algorithms. (BL-02)
2. Find the DFT of a sequence using DIT-FFT. (BL-01)
3. Find the DFT of a sequence using DIF-FFT. (BL-01)
4. Compare the similarities and dissimilarities between DIT & DIF FFT algorithms. (BL-02)

MODULE-3	DESIGN OF IIR FILTERS	11 Hrs
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DESIGN OF IIR FILTERS: Design of IIR filters from analog filters (Butterworth and Chebyshev) IIR filter design by approximation of derivatives, by Impulse invariance, and by bilinear transformation methods, Frequency transformation in digital domains, Illustration with an example.

REALIZATION OF IIR FILTERS: Structures for IIR systems - Direct form, Cascade form, Parallel form and Transposed structures. (3 Hr's)

At the end of the Module 4, students will be able to:

1. Construct IIR filters using different structures. (BL-03)
2. Design IIR filters using Butterworth and Chebyshev filters. (BL-04)
3. Design IIR filters using Impulse invariance and bilinear transformation methods. (BL-04)
1. Translate IIR filters in digital domain. (BL-02)

MODULE-4	DESIGN OF FIR FILTERS	10 Hrs
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DESIGN OF FIR FILTERS: Introduction to FIR filters, Linear phase FIR filters, design of FIR filters using Rectangular, Hanning, Hamming, Bartlet and Blackman windows, Illustrative problems.

REALIZATION OF FIR FILTERS: Structures for FIR systems- Direct form and Cascade form, Comparison of FIR and IIR filters.

At the end of the Module 3, students will be able to:

2. Construct FIR filters using different structures. (BL-03)
3. Design FIR filters using windowing techniques. (BL-04)
4. Design linear phase FIR filters using various techniques. (BL-04)

MODULE-5	ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES	08 Hrs
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Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit.

At the end of the Module 6, students will be able to:

1. List the architectural features of Programmable DSPs. (BL-01)
2. Explain the addressing modes of PDSPs. (BL-02)
3. Summarize the speed issues of programmable DSPs. (BL-02)

Total hours:	48 hours
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Content beyond syllabus:

1. Addressing modes of TMS320C54XX Processors.
2. Pipeline Operation of TMS320C54XX Processors.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Introduction to Digital signal Processing	https://www.tutorialspoint.com/digital_signal_processing/index.htm
2	Fast Fourier Transforms	https://www.youtube.com/watch?v=EsJGuI7e_ZQ

4	Design of IIR by Bilinear transformation method	https://www.youtube.com/watch?v=g8o511OswfQ	
4	Design of FIR using Windowing Techniques	https://www.youtube.com/watch?v=5JpqbURCjEE	
5	Architectures for Programmable DSP Devices	https://www.youtube.com/watch?v=tkGRGQZhczs	

Text Book(s):

1. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications," Pearson Education/PHI, 4 th ed., 2007.
2. Avtar Singh and S. Srinivasan, "Digital Signal Processing," Thomson Publications, 2004.
3. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, "Digital signal processing", Tata McGraw Hill, 2 nd edition, 2011

Reference Book(s):

1. Sanjit K Mitra, "Digital signal processing, A computer base approach," Tata McGraw Hill, 3 rd edition, 2009
2. B. P. Lathi, "Principles of Signal Processing and Linear Systems," Oxford Univ. Press, 2011.
3. A. V. Oppenheim and R.W. Schaffer, & J R Buck, "Discrete Time Signal Processing," 2nd, Pearson Education, 2012.

Online Resources:

1. <https://nptel.ac.in/courses/117/102/117102060/>
2. <https://www.youtube.com/watch?v=3OFNS8lxa-0>
4. <https://www.youtube.com/watch?v=4Q-R1E5B40Q>
5. <https://www.youtube.com/watch?v=vIFdVYAXIlg>
6. <https://www.youtube.com/watch?v=G-Jzz9fm6qo>

Web Resources:

1. https://engineering.purdue.edu/~ee538/DSP_Text_3rdEdition.pdf
2. https://drive.google.com/file/d/1sKEazTJieOS_eVwC6Yh5rDLCWNPXFXpa/view
3. https://books.google.co.in/books?id=5zO6An_gAgC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2013	VLSI DESIGN							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VI	3	0	0	48	3	40	60	100
Pre-requisite: Basics of semiconductor devices, Electronics circuits, Digital logic Design, Physics.								
Course Objectives:								
1. To understand the fabrication process of MOS, CMOS, Bi-CMOS Transistors, the electrical properties of MOS circuits								
2.To Know the design rules, layout diagrams, stick diagrams and will also acquaint with knowledge on electrical constraint while designing								
3. To know the design of various complex logic gates using CMOS and other forms of logic.								
4.Subsystem design is used in VLSI integrated circuits for adders, multipliers, shifters, ALUs and Array Subsystems used in sequential circuit designs i.e. SRAM, DRAM.								
5 To know the architectural details of FPGAs, CPLDs and procedural steps to develop semiconductor ICs like Full-Custom, Semi-Custom & programmable ICs.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the MOS Device Equations & CMOS basic inverter characteristics. (BL-4).							
CO 2	Apply the concepts of stick diagrams and layout design rules for CMOS Circuits. (BL-3).							
CO 3	Design the digital complex logic gate design of various types using CMOS and other forms of logic. (BL-3).							
CO 4	Develop various Data Path subsystems, parity generators, and array of memories to compensate trade-off area, speed and power requirements. (BL-3).							
CO 5	Implement digital logic circuits using PLAs, FPGAs and CPLDs. (BL-4).							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3		2								2	1
CO 2	3	3	3										3	3
CO 3	3	3	3	3	1									3
CO 4	3	3	3	1	1								3	1
CO5	3	2	2	1	3								3	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE-1	Introduction to MOS Technologies	12 hours
Introduction to integrated circuit technologies, Basic of MOS transistors, enhancement mode MOS transistor, depletion mode MOS transistor, NMOS and CMOS fabrication, BICMOS.		
ELECTRICAL PROPERTIES : I_{ds} - V_{ds} relationships, Threshold Voltage, Body effect, Channel length modulation, g_m , g_{ds} , figure of merit ω_0 , Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Latch-up in CMOS circuits		

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate the evolution of Integrated Circuits and MOS Technologies. (BL-2). 2. Compare Bipolar, NMOS, CMOS, BICMOS and GaAs technologies. (BL-2). 3. Explain PMOS Fabrication Process. (BL-2). 4. Interpret the fundamentals of MOS devices and its V-I characteristics.(BL- 4) 5. Compare the relative merits of the three different forms of pull-up for an inverter circuit.(BL-2). 		
MODULE-2	VLSI CIRCUIT DESIGN PROCESS	9 hours
VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μ m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS, CMOS Inverters and Gates, Scaling of MOS Circuits: Scaling models, Scaling factors for device parameters, Limitations of Scaling.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Develop the Layout of simple MOS circuits using Lambda based design rules. (BL-3). 2. Demonstrate how the NMOS, CMOS transistors layouts are built using 2μm CMOS Design rules. 3. Illustrate the scaling models and scaling factors for NMOS,PMOS and CMOS Devices.(BL-2) 4. Infer the limitations of scaling. 		
MODULE-3	GATE LEVEL DESIGN	9 hours
Logic gates and other complex gates, Switch logic, Other Forms of CMOS Logic: Pseudo-nMOS logic, Dynamic CMOS logic, Clocked CMOS (C ² MOS) logic, CMOS Domino Logic, n-p CMOS logic.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Demonstrate any logic function into Gate level design. (BL-2) 2. Illustrate various logic circuits with different design styles. (BL-2) 3. Explain CMOS domino logic and give its advantages and disadvantages. (BL-2) 4. Compare the other forms of CMOS Logic. (BL-2) 		
MODULE-4	DATA PATH SUBSYSTEMS	9 hours
Shifters, Design of an ALU Subsystem, Adders, Multipliers, Parity generators, SRAM, DRAM, ROM, Serial Access Memories, and Content Addressable Memory.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Interpret the different architectures for adders.(BL-2) 2. Identify the speed and area trade off Adders, Multipliers and shifters.(BL-3) 3. Demonstrate the working principle and operation of different Memories. (BL-2). 4. Illustrate the read and write operations in static RAM with neat diagram. (BL-2) 		
MODULE-5	IMPLEMENTATION STRATEGIES	9hours
Full custom, Standard Cell, Gate Array based ASICs, PLA, PAL, PLD, and CPLD & FPGA Architecture. Programmable Array Logic, Design Approach.		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate the techniques of chip design using programmable devices. (BL-2). 2. Demonstrate the architecture and routing procedures of CPLD & FPGA. (BL-2). 		
Total hours:		48 hours

Content beyond syllabus:

Physical Design: Floor-Planning, Placement and Routing.

Self-Study: Contents to promote self-Learning:

SNO	Module	Reference
1	Introduction to MOS Technologies & Fab Basic Electrical Properties of MOS & Bi-CMOS Circuits.	https://www.youtube.com/watch?v=lpXNCwsnxjM (Integrated Circuit Technology) https://www.youtube.com/watch?v=kcJi8gJ1kBo (History-Future Trends) https://www.youtube.com/watch?v=WsdVCCJsyfU (Evolution Integrated Circuits) https://www.youtube.com/watch?v=9SnR3M3CIm4&t=243s (Introduction to VLSI Design Basics) https://www.youtube.com/watch?v=WBa2Fw5-yU4 (MOS Transistor Switches and CMOS Logic) https://www.youtube.com/watch?v=p4E1to95w_w&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=13&t=0s (Enhancement mode MOSFET Operation) https://www.youtube.com/watch?v=b6QRdt0xZwA&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=13 (Depletion mode MOSFET Operation) https://www.youtube.com/watch?v=ptLeMiTgwJA (NMOS Fabrication Process). https://www.youtube.com/watch?v=QUExo3nSyxY (CMOS Fabrication) https://www.youtube.com/watch?v=b827fsVm7_4 (Fabrication of n-well Process) https://www.youtube.com/watch?v=2bdAYqZqudQ (Continuation of p-well) https://www.youtube.com/watch?v=Cld7ux8kQi8 (Twin Tub) https://www.youtube.com/watch?v=-4jOzGN0GTw (BiCMOS Fabrication Process) https://www.youtube.com/watch?v=y3cSgK-wmFs (SOI Process). https://www.youtube.com/watch?v=hHVbFHjccO8 (Resistors) https://www.youtube.com/watch?v=jp72NWXdkvA (Integrated resistor and Capacitor) https://www.youtube.com/watch?v=rpuddEum2k&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=2&t=0s (Basic Electrical Properties part-1) https://www.youtube.com/watch?v=C2mm4UbPIT0&list=

		<p>PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=3&t=0s (Part-2) https://www.youtube.com/watch?v=L7s9Ar0XdMw&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=4&t=0s (Part-3) https://www.youtube.com/watch?v=CpK-3w8zURI (nMOS Logic Circuits-Pull-ups) https://www.youtube.com/watch?v=fqiYu6IOtmU(CMOS Inverter Analysis) https://www.youtube.com/watch?v=57U1LxJD0kc&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=5&t=0s(BICMOS) https://www.youtube.com/watch?v=uihFUbOTIzM Latchup in CMOS Logic</p>	
2	VLSI Circuit design Processes	<p>https://www.youtube.com/watch?v=x68G7FUP9k4 https://www.youtube.com/watch?v=iRoazTYnJqo (Stick Diagrams) https://www.youtube.com/watch?v=Ew1ii_XYdtg&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=2&t=0s -1 https://www.youtube.com/watch?v=tT511b3qLWc&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=3&t=0s -2 https://www.youtube.com/watch?v=k4EnmTuIepE&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=4&t=0s -3 https://www.youtube.com/watch?v=GpVHcXoZkA0&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=5&t=0s -4 https://www.youtube.com/watch?v=jkofN9fhHK8&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=6&t=0s - 5 https://www.youtube.com/watch?v=SC4nDbebpsM&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=12&t=0s- (CMOS XOR Gate) https://www.youtube.com/watch?v=D_M_6xgyxjo&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=9&t=0s (Design Rules and layout for cmos logic gates) https://www.youtube.com/watch?v=1aqKlr0NsiU (MOS LAYERS,STICK Diagrams, Design Rules and Layout) https://www.youtube.com/watch?v=vXb3miSeXZw&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=12&t=0s</p>	

		gsYt2XrfniG&index=10&t=0s (Types of contact Cuts) https://www.youtube.com/playlist?list=PLqilb1UO8M-W65iA7Pr8E3_QyWHgnon1S (Basic Circuit Concepts)
3	Gate Level Design	https://www.youtube.com/watch?v=8caQpnxa3iE (CMOS NAND,NOR and Other Gates: Clocked CMOS) https://www.youtube.com/watch?v=q8adOpQx7tc (Dynamic CMOS,Pass transistor, Transmission gate)
4	Data Path Subsystems	https://www.youtube.com/playlist?list=PLqilb1UO8M-US31joQFPJ4juX1sX9KkcH (VLSI Subsystem Design) https://www.youtube.com/watch?v=36hCizOk4PA (Half & Full Adder, Carrylook ahead adder) https://www.youtube.com/watch?v=4ukbN83kY54&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=26&t=0s (Design of 4 Bit ALU) https://www.youtube.com/watch?v=Lc-AWOJ1qwo&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=27&t=0s (Carry select adder, carry skip adder, CLA) https://www.youtube.com/watch?v=EMcW9EggY0s&list=PLbMVogVj5nJTD6KqQXNexCvooSMnBuXj&index=13 (Multipliers) https://www.youtube.com/watch?v=5-PI4T25OXI&list=PLZe4P0P_9CovC7jP0URDHzI31kkTEMS70&index= (Array Multiplier) https://www.youtube.com/watch?v=5PVweRB4QvY&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=24&t=0s (4 Bit Barrel Shifter) https://www.youtube.com/watch?v=HuSWjf0NToI (Parity generator) https://www.youtube.com/watch?v=dmBc-E3EpgA https://www.youtube.com/watch?v=k5VBJcUcaWU (High Density Memories) https://www.youtube.com/watch?v=wNNtz_My2ps (DRAM)
5	Semiconductor Integrated Circuit Design	https://www.youtube.com/watch?v=JAN7odb8n90 (Full Custom, semi Custom etc) https://www.youtube.com/watch?v=gCAYY0fHPq4 (PLDS:PLA,PAL,CPLD,FPGA)

			https://www.youtube.com/watch?v=khZkhE6wJis (Vlsi Design Methodology) https://www.youtube.com/watch?v=CLUoWkJUnN0&list=PLB19593440B2BB5DC&index=36&t=0s (Introduction to FPGA) https://www.youtube.com/watch?v=tJGtT9ky3H0 CPLD Architecture https://www.youtube.com/watch?v=kg5FAIAQdmU CPLD &FPGA https://www.youtube.com/watch?v=r8bziBVnPdU https://www.youtube.com/watch?v=0nMHJ0VoYhY FPGA Architecture https://www.youtube.com/watch?v=n0x1jhsZDUg&list=PLB19593	
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Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, *Essentials of VLSI Circuits and Systems*, PHI, 2005.
2. P.P. Sahu, *VLSI Design*, TMH, 1st edition 2013.
3. K.Lal Kishore and V.S.V. Prabhakar, “VLSI DESIGN”, IK Publishers, 1st edition 2009

Reference Books:

1. John P Uyemura, *Introduction to VLSI Circuits and Systems*, Wiley India, 2006
2. Jhon F. Wakerly, “*Digital Design Principles & Practices*”, Pearson Education Asia, 3rd Edition, 2005.
3. John M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, PHI, 2nd Edition, 1997.
4. Wayne Wolf, “*Modern VLSI Design*”, Pearson Education, 3rd Edition, 2008.
5. Sabastian smith, “*Application Specific Integrated Circuits*”, Addison Wesley Publishing Company Incorporated, 2008
6. *Principles of CMOS VLSI Design- Weste and Eshraghian*, Pearson Education, 1999

Online Resources:

1. <https://www.y2mate.com/youtube/faiEVOOCe-s>
2. <https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering--advanced-vlsi-design-video-lecture--ECE--EC117101004V.html>
3. <https://www.youtube.com/watch?v=khZkhE6wJis>
4. <https://www.youtube.com/watch?v=m86zSu8vbZE>
5. <https://www.youtube.com/watch?v=W7LhLL75DYo>
6. https://www.youtube.com/watch?v=Ew1ii_XYdtg&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG

Web References:

1. <https://nptel.ac.in/courses/117/101/117101058/>
2. http://www.powershow.com/view/3d1876-Y2ViN/Design_Rules_EE213_VLSI_Design_Stick_Diagrams_VLSI_design_powerpoint_ppt_presentation
3. <http://www.faadooengineers.com/threads/2274-VLSI-Tutorial-Full-Detailed-EbookPresentation-amp-Lecture-Notes>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2507	DIGITAL SIGNAL PROCESSING LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	0	0	3	42	1.5	40	60	100
Pre-requisite: Knowledge on Signals and Systems and Matlab.								
Course Objectives:								
1. To analyze various continuous and discrete time signals using matlab functions.								
2. To demonstrate the use of DFT to efficiently process discrete time signals in the frequency domain.								
3. To design aspects of FIR and IIR filters for given specifications.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze discrete time signals & systems using MATLAB							
CO 2	Design & implement IIR & FIR filters for different specifications							
CO 3	Design DSP based real time processing systems to meet desired needs of the society							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3							2	2		2	2	3
CO2	2	2	2		2				2	2		2	2	2
CO3	2	3							2	2		2	2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
PART-A: Software Experiments using MATLAB software (Minimum of 5 experiments are to be conducted)		
Task-1: GENERATION OF DISCRETE TIME SIGNALS		
Objective: To generate various continuous and discrete time signals using MATLAB software.		CO 1
Task-2: ENERGY AND POWER OF A SIGNAL		
Objective: To find the energy and power of a given discrete time signal using MATLAB software.		CO 1
Task-3: DFT		
Objective: To find the DFT of a given sequence using MATLAB software.		CO 2
Task-4: BUTTERWORTH IIR FILTER		
Objective: To design and implement IIR Butterworth (LP/HP) filter using MATLAB software.		CO 3
Task-5: FIR LOW PASS FILTER		
Objective: To design and implement FIR Low pass filters using any three windows in MATLAB software.		CO 3
Task-6: FIR HIGH PASS FILTER		
Objective: To design and implement FIR high pass filters using any three windows in MATLAB software.		CO 3
Task-7: FIR BAND-PASS FILTER		
Objective: To design and implement FIR band-pass filter using any three windows in MATLAB software.		CO 3
PART-B: Using DSP Processor kits (Floating point) and Code Composer Studio (CCS)		
Task-8: GENERATION OF DISCRETE TIME SIGNALS		
Objective: To generate various continuous and discrete time signals using DSP Processor and		CO 1

CC studio.	
Task-9: ENERGY AND POWER OF A SIGNAL	
Objective: To find energy and power of a given discrete time signal using CC studio.	CO 1
Task-10: DFT	
Objective: To find the DFT of a given sequence using CC studio.	CO 2
Task-11: FIR FILTER	
Objective: To design and implement FIR filters using CC Studio.	CO 3
Task-12: IIR FILTER	
Objective: To design and implement IIR filters using CC Studio.	CO 3

Additional Experiments:	
Task-13: CIRCULAR CONVOLUTION	
Objective: To find circular convolution of given two discrete time signals using MATLAB software.	CO 1
TASK-14: N-POINT DIF-FFT ALGORITHM	
Objective: To find the DFT of a given sequence using DIF FFT algorithm in MATLAB software.	CO 2
Virtual Labs:	
<ol style="list-style-type: none"> Study of Discrete Fourier Transform (DFT) and its inverse http://vlabs.iitkgp.ernet.in/dsp/exp6/index.html FIR Filter Design http://vlabs.iitkgp.ernet.in/dsp/exp8/index.html (High pass FIR Filter) http://vlabs.iitkgp.ernet.in/dsp/exp9/index.html (Band pass and Bandstop FIR filter) IIR Filter http://vlabs.iitkgp.ernet.in/dsp/exp10/index.html 	

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Generation of random sequence	https://www.youtube.com/watch?v=xs2de3YBgZM
2	Energy and power of a signal	https://www.youtube.com/watch?v=Zo7CuL736GU
5	DTFT	https://www.youtube.com/watch?v=QLCXSxgxRPY
6.	N-Point FFT Algorithm	https://www.youtube.com/watch?v=nqaFs-msgUQ (DIT-FFT) https://www.youtube.com/watch?v=6yNcDybxso (DIF-FFT)
7.	FIR Filter Design	https://www.youtube.com/watch?v=mXVIFJOMyIM (Windowing Techniques)
8.	IIR Filter Design	https://www.youtube.com/watch?v=OCHfpmACqMM (Impulse Invariance method) https://www.youtube.com/watch?v=O0DbpZqhPSg (Frequency Sampling method) https://www.youtube.com/watch?v=zQQF5orJbdg (Chebyshev Filter)

Text Book(s):

1. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications," Pearson Education/PHI, 4 th ed., 2007.
2. Sanjit K Mitra, "Digital signal processing, A computer base approach," Tata McGraw Hill, 3 rd edition, 2009
3. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, "Digital signal processing", Tata McGraw Hill, 2 nd edition, 2011

Reference Book(s):

1. A.V.Oppenheim and R.W. Schaffer, & J R Buck, "Discrete Time Signal Processing," 2 nd ed., Pearson Education, 2012.
2. B. P. Lathi, "Principles of Signal Processing and Linear Systems," Oxford Univ. Press, 2011.
3. Li Tan, Jean Jiang, "Digital Signal Processing, Fundamentals and Applications," Academic Press, Second Edition, 2013
4. P. Ramesh Babu, "Digital Signal Processing", 4th edition, 2006, SCITECH publication, India.

Web References:

1. <https://ewh.ieee.org/r1/ct/sps/PDF/MATLAB/chapter6.pdf>
2. http://aaronscher.com/Course_materials/Communication_Systems/documents/Energy_signals_matlab_tutorial.pdf
3. <https://gist.github.com/yassersouri/4154139>
4. <http://matlab.izmiran.ru/help/techdoc/ref/fft.html>
5. <https://in.mathworks.com/help/signal/ref/fir1.html>
6. <https://in.mathworks.com/help/signal/ug/iir-filter-design.html>

-NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2508	Integrated Circuits Laboratory							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	0	0	3	36	1.5	40	60	100
Pre-requisite: Basic knowledge of Electronic Devices and circuits, Knowledge on dual power supply connections.								
Course Objectives:								
1.To understand the characteristics of operational amplifier 2. To Apply Operational Amplifiers in linear and non-linear applications. 3. To Design different types of active filters. 4.To Design and construct waveform generation circuits 5. To understand the designing industrial applications using 555 timer.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Illustrate the working of Op amp ICs & Application specific analog ICs.							
CO 2	Analyze operational amplifier based circuits for linear and non-linear applications.							
CO 3	Design Operational amplifiers for linear and nonlinear application, Multivibrator circuits using 555 & application specific ICs.							
CO 4	Simulate all linear and nonlinear application based Op amp Circuits and circuits based on application specific ICs.							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2							3	3		2	3	
CO2	2	2	2						3	3		2	3	
CO3	2	2	2						3	3		2	3	2
CO4	2	2	2						3	3		2	3	2

1: Low, 2-Medium, 3- High

Note: List of Experiments (At least twelve experiments are to be done):

COURSE CONTENT	CO
Task-1: Inverting, Non-Inverting & Unity Gain Amplifiers Using IC 741 Op-Amp	
Objective: To determine voltage gain and frequency response of inverting, non-inverting & unity Gain amplifiers using IC 741 Op-Amp.	CO 1
Task-2: Measurement of Op-Amp Parameters	
Objective: To measure offset voltages, bias currents, CMRR, Slew Rate using IC-741 Op-Amp.	CO 1
Task-3: Integrator & Differentiator Using IC 741 Op-Amps.	

Objective: To design, construct and verify the response of a) Integrator using Op-amp IC741 for sine and square wave inputs at 1 KHzfrequency. b) Differentiator using Op-amp IC741 for sine and square wave inputs at 1 KHzfrequency.	CO 2
Task-4: Op-Amp Applications-Zero Crossing detector, Window Detector & Schmitt trigger.	CO2
Objective: To study Zero Crossing detector, Window detector & Schmitt trigger using Op-Amp.	
Task-5: Op-Amp Applications-Signal Converters.	
Objective: To Construct suitable circuits for voltage to current converter and current to voltage converters using Op-Amp.	CO 2
Task-6: Instrumentation Amplifier Using IC 741 Op-Amps.	
Objective: To design an instrumentation amplifier and determine its voltage gain using IC-741 Op-Amp.	CO 3
Task-7: Function Generator Using IC 741 Op-Amps.	
Objective: To generate triangular and square wave forms and to determine the time period of the wave forms.	CO 3
Task-8:RC PHASE SHIFT OSCILLATOR AND WEIN BRIDGE OSCILLATOR	
Objective: To study the Operation of Wein – Bridge Oscillator and RC phase shift oscillator using IC 741 Op-Amp and to determine the frequency of Oscillations.	CO 3
Task-9: DESIGN OF ACTIVE FILTERS (LPF, HPF)	
Objective: To design, construct and plot the frequency response of a) First order low pass filter with cut-off frequency of 5KHz b) First order high pass filter with a cut-off frequency of 1KHz.	CO3
Task-10: Astable Multivibrator Using IC 555 Timers.	CO4
Objective: To obtain a symmetric square wave output wave forms by maintaining certain duty cycle by using 555 timers.	
Task-11: Monostable Multivibrator Using IC 555 Timers.	
Objective: To design a Monostable Multivibrator using 555 timer to get 10msec pulse output.	
Task-12: Data converters using Op-amp	
Objective: To obtain analog output voltages for the digital input data using 3-bit binary weighted resistor type DAC using Op-Amp.	CO5

Additional Experiments:	
Task-13: Low Drop Out Regulator Using IC 741 Op-Amps.	
Objective: Design and test a low Dropout regulator using op-amps for a given voltage regulation characteristic Using IC 741 Op-Amp.	CO5

Task-14: DC-DC Converter Using IC 741 Op-Amps.	
Objective: Design of a switched mode power supply that can provide a regulated output voltage for a given input range using IC 741 Op-Amp.	CO 5
Virtual Labs: <ol style="list-style-type: none"> 1. Study of basic properties of operational amplifier: inverting and non-inverting amplifiers. 2. Study of differentiator and integrator using operational amplifier. 3. Design and simulate triangular/square waveform generator using IC 741. 4. Design and simulate Frequency response of 1st order HPF and LPF filter. 	

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	Amplifiers & Parameters	CO1	https://www.youtube.com/watch?v=ImTzh3kgnvA https://www.youtube.com/watch?v=jonWWaBdMNU https://www.youtube.com/watch?v=C5GcP5P25Jo https://www.youtube.com/watch?v=mgoCeOCjiBI&list=PL1hqL6v9rNg4tKlAW7p4vn26yRyu8XdfJ&index=41
2	Op-Amp Applications	CO2	https://www.youtube.com/watch?v=mgoCeOCjiBI&list=PL1hqL6v9rNg4tKlAW7p4vn26yRyu8XdfJ&index=41 https://www.youtube.com/watch?v=cXmmlwVaA0k (Schmitt trigger using IC 741)
3	IC 555 Timers, IC 565 PLL and IC 566 VCO	CO3	https://www.youtube.com/watch?v=75hYqRtLJTQ (Astable using 555) https://www.youtube.com/watch?v=j_cJ7DV_T_M (IC565 PLL) https://www.youtube.com/watch?v=S_v70oFKmnw (IC566 VCO).
4	Active Filters & D-A Converters	CO4	https://www.youtube.com/watch?v=mgoCeOCjiBI&list=PL1hqL6v9rNg4tKlAW7p4vn26yRyu8XdfJ&index=41

Data sheets:

1. <https://www.ti.com/lit/ds/symlink/ua741.pdf>.
2. <https://www.st.com/resource/en/datasheet/cd00000479.pdf>
3. <http://eeshop.unl.edu/pdf/lm565.pdf>

Reference Book(s):

1. <https://datasheetspdf.com/pdf-file/514046/NXP/NE565/1>
2. http://www.elektronikjk.com/elementy_czynne/IC/NE566.pdf

Web Resources for Virtual Lab:

1.<http://vlabs.iitkgp.ernet.in/be/index.html>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2509	VLSI DESIGN LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	0	0	3	36	1.5	40	60	100
Pre-requisite: A course on Microwave and optical communications.								
Course Objectives:								
1. To understand how to measure different performance parameters of the circuits. 2. To Create some innovative ideas for the students to design various circuits to satisfy the performance parameters of the design. 3. To design the layouts for logic circuits								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Develop Verilog HDL source code for the given problem/experiment, and simulate the given circuit with suitable simulator and verify the results.							
CO 2	Analyze the obtained results of the given experiment/problem.							
CO 3	Implement the experiments using FPGA/CPLD hardware tools.							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2						2	3		2	2	3
CO2	3	2	2						2	3		2	2	3
CO3	3	3	2						2	3		2	2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT	CO
Task-1: Realization of Logic gates	
Objective: Develop VERILOG model for all basic gates and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-2: Design and Implementation of 4-Bit ripple carry and carry look ahead adder using Behavioral, Dataflow and Structural modeling.	
Objective: Develop the VERILOG model for 4-bit ripple carry adder and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-3: Design and Implementation of 16 to 1 mux through 4 to 1 mux.	
Objective: Develop the VERILOG model for 16:1 mux. through 4:1 mux. and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-4: Design and Implementation of 8 to 3 encoder.	

Objective: Develop the VERILOG model for 8 to 3 encoder to and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-5: Design and Implementation of 8-bit parity generator and checker.	
Objective: Develop the VERILOG model for 8-bit parity generator and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-6: Design and Implementation of D-Flip-Flop.	
Objective: Develop the VERILOG model for D-flip flop and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-7: Design and Implementation of 8 bit synchronous up-down counter.	
Objective: Develop the VERILOG model for 8-bit synchronous up-down counter and simulate to verify the functionality and synthesize to verify the RTL schematic.	CO 1
Task-8: Design and simulate a CMOS Inverter	
Objective: To generate layout for inverter using Tanner/Micro wind tool or equivalent industry standard software and simulate to verify the functionality.	CO 2
Task-9: Design and simulate CMOS NAND and NOR Gate.	
Objective: (1) To generate layout for NAND gate using Tanner/Micro Wind tool or equivalent industry standard software and simulate to verify the functionality. (2) To generate layout for NOR Gate using Tanner/Micro Wind Tool or Equivalent Industry Standard Software and simulate to verify the functionality.	CO 2
Task10: Design and simulate CMOS Full Adder.	
Objective: To generate layout for FULL ADDER using Tanner/Micro wind tool or equivalent industry standard software and simulate to verify the functionality.	CO 2
Task-11: Design and simulate CMOS Full Subtractor.	
Objective: To generate layout for Full Subtractor using Tanner/Micro Wind Tool or equivalent Industry Standard Software and simulate to verify the functionality.	CO3
Task-12: Design and simulate D-Latch using CMOS.	
Objective: To generate layout for a D-Latch using Tanner/Micro wind tool or equivalent industry standard software and simulate to verify the functionality.	CO 3

Additional Experiments:		
Task-13: Design and Implementation of 4-bit sequence detector through Mealy state machines.		
Objective: Develop VHDL model for 4-bit sequence detector using Mealy state machines to simulate to verify the functionality and synthesize to verify the RTL schematic.		CO 3
Task-14: Design and simulate 2 to 4 Decoder using CMOS.		
Objective: Develop VHDL model for 2 to 4 decoder using Tanner/Micro wind tool or equivalent industry standard software and simulate to verify the functionality.		CO 2

Self-Study:

Contents to promote self-Learning:

SN O	Topic	Reference
1	MOSFETS	https://www.youtube.com/watch?v=H7Gdz4QTvUU
2	CMOS Inverter	https://www.youtube.com/watch?v=U3GfEHDrOaQ
4	Logic Gates	https://www.youtube.com/watch?v=cXeJGuAvh64 https://www.youtube.com/watch?v=EHUJda2ttU8
5	4X1 Multiplexer	https://www.youtube.com/watch?v=WmwtSMYSZfl
6	Latches	http://vlab.amrita.edu/?sub=3&brch=165&sim=907&cnt=2643
7	Two Input NAND & NOR Gates	https://www.youtube.com/watch?v=KfFALBexgfY https://www.youtube.com/watch?v=h4P0rIzyTtY https://www.youtube.com/watch?v=W-kMzdOpf9M
8	CMOS Inverters	https://www.youtube.com/watch?v=5FF5uRpWbjo https://www.youtube.com/watch?v=YLh9BpFpvDU https://www.youtube.com/watch?v=FqzzpobtL8c

Text Book(s):

1. KamranEshraghian, Eshraghian Douglas and A. Pucknell, "Essentials of VLSI circuits and systems", PHI, 2013 edition.
2. K.Lal Kishore and V.S.V. Prabhakar, "VLSI Design", IK Publishers
3. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill Publications, 2002.

Reference Book(s):

1. J.M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, 2nd edition, PHI, 2003.
2. Weste, CMOS VLSI Design: A Circuits And Systems Perspective ,3rd edition, Pearson Education India, 2007.

Web References:

1. <https://nptel.ac.in/courses/117/101/117101058/>
2. http://www.powershow.com/view/3d1876-Y2ViN/Design_Rules_EE213_VLSI_Design_Stick_Diagrams_VLSI_design_powerpoint_ppt_presentation
3. <http://www.faadooengineers.com/threads/2274-VLSI-Tutorial-Full-Detailed-EbookPresentation-amp-Lecture-Notes>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2014	MICROWAVE & OPTICAL COMMUNICATIONS						R20	
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VII	3	0	0	48	3	40	60	100
Pre-requisite: EMTL, Engineering physics								
Course Objectives:								
<ol style="list-style-type: none"> To apply Electromagnetic Theory for calculating waveguides and transmission lines To Summarize microwave system and components in terms of network theory(scattering Matrix To illustrate microwave components such as ferrite devices To outline the basic elements of optical fiber transmission link, fiber modes configurations and structures To Summarize the various optical source materials, LED structures, quantum efficiency, Laser diodes and applications 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret the importance of waveguides							
CO 2	Illustrate the working of passive devices							
CO 3	Differentiate Linear bean tubes and crossed field tubes in terms of operation and performance							
CO 4	Analyze the signal propagation in optical fibers							
CO 5	Select appropriate optical sources and detectors for specific applications							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1										1	
CO2	3	3	1	1									1	
CO3	3	3	1	1									3	
CO4	3	3	1	1									1	
CO5	3	3	1	1		1							3	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	WAVEGUIDES	9 Hrs
WAVEGUIDES AND COMPONENTS: Introduction, microwave spectrum and bands, applications of microwaves. Rectangular waveguides, circular waveguides, microwave cavities.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain impedance matching network for any transmission line or system. (BL-02) 		

<ol style="list-style-type: none"> 2. Understand various parameters of waveguide and use of component as per applications. (BL-02) 3. Find impedance by using smith chart. (BL-01) 4. Explain various waveguides. (BL-02) 5. Summarize various waveguide components. (BL-02) 		
MODULE-2	MICROWAVE PASSIVE COMPONENTS	9 Hrs
<p>Microwave passive devices : Microwave hybrid circuits, directional couplers, circulators and isolators. Coaxial connectors, adapters, Phase shifters, Attenuators, Waveguide Tees. Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain different parameters of two port devices. (BL-02) 2. Understand the operation of various passive devices and find their application in various fields. (BL-02) 3. Find the S matrix of multiport networks. (BL-01) 4. Understand Symmetrical Z and Y parameters. (BL-02) 5. Summarize various Microwave passive devices. (BL-01) 		
MODULE-3	MICROWAVE TUBES AND MEASUREMENTS	10 Hrs
<p>Microwave Tubes: (i) Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT). (ii) Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition, Mode jumping in Magnetron Microwave measurements: microwave bench, errors and precautions, power, attenuation, frequency, standing wave, impedance measurements.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand principle of operation of Microwave Tubes (BL-1) 2. Understand principle of operation of Microwave Semiconductor devices (BL-1) 3. Derive the expressions power output and efficiency of all microwave devices (BL3) 4. Differentiate Linear beam tubes and crossed field tubes in terms of operation and performance (BL5) 		
MODULE-4	INTRODUCTION TO OPTICAL FIBERS	10 Hrs
<p>Evolution of fiber optic system-Elements of an Optical Fiber Transmission link-Ray Optics-Optical Fiber Modes and Configurations. Single Mode Fibers-Graded Index fibers Structure. Signal Degradation Optical Fibers: Attenuation–Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the fundamental principles of optics and light wave. (BL-02) 2. Explain the transmission characteristics of optical fiber. (BL-02) 3. Explain various losses in optical fibers. (BL-02) 4. Illustrate the signal distortion in optical waveguides. (BL-02) 5. Explain different fibers structures. (BL-02) 		
MODULE-5	FIBER OPTICAL COMPONENTS AND APPLICATIONS	10 Hrs

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, PIN and APD diodes.
Applications of optical communication: Telephony, Telemetry, video distribution, military applications.

At the end of the Module 5, students will be able to:

1. Explain optical fiber communication links using appropriate optical fibers light sources. **(BL-02)**
2. Outline the various LED structures. **(BL-02)**
3. Explain the terms quantum efficiency, LED power, Modulation of a LED. **(BL-02)**
4. Explain the operation of LASER PIN,APD diodes. **(BL-02)**
5. List various applications of Fiber optical receivers. **(BL-01)**

Total hours: 48hours

Term work: Able to analyze and find applications and limitations of microwave tubes and Amplifiers, Explore concept of designing and operating principles of modern optical systems

Content beyond syllabus:

1. Flexible branching of an optical fiber.
2. Expanding applications of bending-loss-resistant fiber

Self-Study:

Contents to promote self-Learning:

SN O	Topic	Reference
1	Microwave transmission lines	https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_transmission_lines.htm
2	Microwave network theory and passive devices	https://www.youtube.com/watch?v=tKZ-1AzYLys , https://www.youtube.com/watch?v=rKLy9_mNryw
3	Microwave Tubes and Diodes	http://www.clivepoole.com/wp-content/uploads/2016/07/Lecture-11-Microwave-Semiconductor-Materials-and-Diodes.pdf
4	Fiber optic System	https://www.tutorialspoint.com/principles_of_communication/principles_of_optical_fiber_communications.ht
5	Fiber optical sources &receivers	https://www.youtube.com/watch?v=nmcl8SVUrNA https://www.electronics-notes.com/articles/connectivity/fibre-optics/optical-receiver.php

Text Book(s):

1. Microwave devices and Circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave principles-Herbert J.Reich,J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS publishers and distributors, New Delhi,2004
3. GerdKeiser,“OpticalFiberCommunication”McGraw–HillInternational,Singapore,3rded.,2000
4. J.Senior,“OpticalCommunication,PrinciplesandPractice”,PrenticeHallofIndia,1994

Reference Book(s):

1. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002
2. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd.,New age International publishers Ltd., 1995.
3. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.
4. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4th Edition, 1995
5. Microwave Engineering – A. Das, TMH, 2nd ed., 2009
6. MaxMing-KangLiu,“Principles and Applications of Optical Communications” ,TMH,2010.2
- .S.C.Gupta,“Textbook on optical fiber communication and its applications”,PHI,2005.
7. Satish Kumar,“Fundamentals of Optical Fiber communications”,PHI,2009

Online Resources:

1. [w.youtube.com/watch?v=pavBq7HIoIE](https://www.youtube.com/watch?v=pavBq7HIoIE) [https://ww](https://www)
2. [w.youtube.com/watch?v=q6_q2IBm93o](https://www.youtube.com/watch?v=q6_q2IBm93o) [https://ww](https://www)
3. [w.youtube.com/watch?v=WR4559RqRzU](https://www.youtube.com/watch?v=WR4559RqRzU) [https://ww](https://www)
4. <https://www.digimat.in/nptel/courses/video/108104113/L11.html>
5. <https://www.digimat.in/nptel/courses/video/108104113/L31.html>
6. [w.youtube.com/watch?v=5R0el7gzny5](https://www.youtube.com/watch?v=5R0el7gzny5) [https://ww](https://www)
7. <https://www.youtube.com/watch?v=zVIWCz9vTL4>
8. https://www.youtube.com/watch?v=kMYGs_9wY-U
9. [www.nptel
videos.in/2012/12/advanced-optical-communication.html](http://www.nptel.edu/videos/in/2012/12/advanced-optical-communication.html)

Web References:

1. [w.tutorialspoint.com/microwave_engineering/microwave_engineering_useful_resources.htm](https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_useful_resources.htm) [https://ww](https://www)
2. [w.electronics-notes.com/articles/electronic_components/diode/schottky-barrier-diode.php](https://www.electronics-notes.com/articles/electronic_components/diode/schottky-barrier-diode.php) [https://ww](https://www)
3. [mk4zmvuctmz.cloudfront.net/assets/main/study-material/notes/electronics-communication_engineering_optical-fiber-communication_analog-and-digital-links_notes.pdf](https://d13mk4zmvuctmz.cloudfront.net/assets/main/study-material/notes/electronics-communication_engineering_optical-fiber-communication_analog-and-digital-links_notes.pdf) [https://d13](https://www)
4. [w.microwaves101.com/encyclopedias/books-on-microwave-engineering](https://www.microwaves101.com/encyclopedias/books-on-microwave-engineering) [https://ww](https://www)
5. [w. \[wikipedia.org/wiki/Microwave_engineering\]\(https://en.wikipedia.org/wiki/Microwave_engineering\)](https://en.wikipedia.org/wiki/Microwave_engineering) [https://en.](https://en)
6. [.microwaveeng.com](http://www.microwaveeng.com) <http://www>
7. [.meslmicrowave.com/microwave-integrated-circuits/overview/](http://www.meslmicrowave.com/microwave-integrated-circuits/overview/) <http://www>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC2511	MICROWAVE AND OPTICAL COMMUNICATION LAB							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	0	0	3	36	1.5	40	60	100
Pre-requisite: A course on Microwave and optical communications.								
Course Objectives:								
1. To study and analyze microwave components by measuring various parameters. 2. To verify the characteristics of optical sources. 3. To measure attenuation and distortions in optical fiber link. 4. To analyze radiation pattern of horn antenna								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the waveguides in different modes of operation. (BL-4)							
CO 2	Interpret the limitations of conventional tubes at microwave frequencies and different microwave oscillators & amplifiers. (BL-3)							
CO 3	Analyse the optical fibre communications link. (BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2						2	3		2	2	2
CO2	2	2	2						2	3		2	2	2
CO3	2	3	2						2	3		2	2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
Task-1: Characteristics of a Reflex Klystron And Electronic Tuning		
Objective: Use microwave bench setup to Study the mode characteristics and electronic tuning range of reflex klystron.		CO 3
Task-2: V-I Characteristics of Gunn Oscillator		
Objective: Use microwave bench setup to study the V-I characteristics of GUNN diode and find the threshold voltage and current point.		CO 2
Task-3: To Determine the Attenuation of A Given Unknown Attenuator		
Objective: Use microwave bench setup to determine the attenuation of a given unknown attenuator.		CO 3
Task-4: Multi-Hole Directional Coupler		
Objective: Use microwave bench setup to study the characteristics of directional coupler and determine the different parameters.		CO 2

Task-5: VSWR Measurement		
Objective: Use microwave bench setup to find VSWR and impedance of an unknown load that is connected at the end of the bench set up. Make use of VSWR meter for the measurement of VSWR of a given load.		CO 3
Task 6: Frequency and Wavelength of Waveguide		
Objective: Use microwave bench setup to determine the frequency and wavelength of waveguide.		CO 1
Task-7: Characteristics of Magic Tee		
Objective: Use microwave bench setup to study the characteristics of magic tee and find the scattering parameters.		CO 2
Task-8: Characteristics of Fiber Optic LED		
Objective: To study the characteristics of fiber optic LED and photo detector.		CO 5
Task-9: VI Characteristics of Laser Diode		
Objective: To Measure the VI Characteristics of Laser Diode.		CO 5
Task-10: Optical Fiber Digital Link		
Objective: To set up an optical fiber digital link and to study the relationship between the transmitted and received signal.		CO 4
Task-11: Numerical Aperture of an Optical Fiber		
Objective: To study the numerical aperture of an optical fiber.		CO 4
Task-12: Optical Fiber Analog Link		
Objective: To set up an optical fiber analog link and to study the relationship between the transmitted and received signal.		CO 4

Additional Experiments:		
Task-13: Impedance Measurement		
Objective: Use microwave bench-setup to measure the unknown impedance by using smith chart.		CO 3
Task-14: Characteristics of E-Plane T, H-Plane T		
Objective: Use microwave bench setup to find the S - matrix Characterization of E-Plane T, H-Plane T		CO 2

Tools / Equipment Required:

- 1.Regulated Klystron Power Supply 6 nos.
2. VSWR Meter 6 nos.
3. Milli/Micro Ammeters 10 nos.
4. Multi meters 10 nos.
5. CROs 8 nos.
6. GUNN Power Supply, Pin Moderator4 nos.
7. Relevant Microwave components –
8. Fiber Optic Analog Trainer based LED3 nos.
9. Fiber Optic Analog Trainer based laser2nos.
10. Fiber Optic Digital Trainer 1 no.
11. Fiber cables - (Plastic, Glass)

Virtual Labs:

https://www.iitk.ac.in/mimt_lab/vlab/index.php?pg=/theory&usr=&enc=http://vlab.amrita.edu/index.php?sub=59&brch=163
<http://vlab.amrita.edu/index.php?sub=59&brch=163>

Self-Study:

Contents to promote self-Learning:

S.NO	Topic	CO	Reference
1	Presentation on microwave virtual lab	CO 1	https://youtu.be/SkhPWhmfZzA
2	Reflex Klystron Characteristics	CO2	https://youtu.be/3HczHYTiJ44
3	Characteristics of LED	CO 5	https://youtu.be/TUjrTqkjwBk
4	Characteristics of Laser diode	CO 5	https://youtu.be/Njbg3cDxnoA

Text Book(s):

1. Microwave devices and Circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Microwave principles-Herbert J.Reich, J.G. Skalnik, P.F. Ordnung and H.L. Krauss, CBS publishers and distributors, New Delhi,2004
3. GerdKeiser,“OpticalFiberCommunication”McGraw–HillInternational,Singapore, 3rded.,2000
4. J.Senior,“OpticalCommunication,PrinciplesandPractice”,PrenticeHallofIndia,1994

Reference Book(s):

1. Foundations for microwave engineering-R.E. Collin, IEEE press, John Wiley, 2ndedition, 2002
2. Microwave circuits and passive devices-M.L. Sisodia and G.S. Raghuvanshi,Wiley Eastern Ltd.,New age International publishers Ltd., 1995.
3. Microwave engineering passive circuits-Peter A. Rizzi, PHI, 1999.
4. Electronic and Radio Engineering-F.E. Terman, McGraw-Hill, 4th Edition, 1995
5. M. Ming-Kang Liu, “Principles and Applications of Optical Communications” ,TMH,2010.

Web References:

1. https://www.tutorialspoint.com/microwave_engineering/index.htm
2. https://www.tutorialspoint.com/principles_of_communication/principles_of_optical_fiber_communications.htm
3. <https://nptel.ac.in/courses/108103141>
4. <https://youtu.be/SkhPWhmfZzA>
5. <https://youtu.be/3HczHYTiJ44>
6. <https://youtu.be/TUjrTqkjwBk>
7. <https://youtu.be/Njbg3cDxnoA>

NARAYANA ENGINEERING COLLEGE::GUDUR								
20EC4001	AN INTRODUCTION TO CODING THEORY							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
V	3	0	0	48	3	40	60	100
Pre-requisite: <ul style="list-style-type: none"> • probability, Statistical averages • Integrations, differentiations, partial differentiations • Analog & Digital Communications 								
Course Objectives: <ol style="list-style-type: none"> 1. To understand the concept of linear block codes. 2. To apply source encoding algorithms. 3. To analyze convolutional encoding algorithms. 4. To analyze convolutional decoding algorithms. 5. To analyze the turbo decode 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain linear block codes (BL-2)							
CO 2	Apply source encoding algorithms. (BL-3)							
CO 3	Analyze convolutional encoding algorithms(BL-4)							
CO 4	Analyze the convolutional decoding algorithms (BL-4)							
CO 5	Analyze turbo decode (BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	2							1	2	
CO2	1	2	2	1	1							1	2	
CO3	1	2	2	1	2							1	2	
CO4	2	2	2	1	2							1	2	
CO5	1	2	2	1	1							1	2	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	LINEAR BLOCK CODE	10Hr
Introduction to error control coding - Introduction to linear block codes, generator matrix and parity check matrix, Properties of linear block codes: Syndrome, error detection, Decoding of linear block codes, Distance properties of linear block codes.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> 1. Explain error control coding. (BL-1) 2. Write generator and parity matrix (BL-3) 3. Understand distance properties (BL-2) 		

MODULE -2	HAMMING CODES	9Hr
Some simple linear block codes: Hamming codes, Repetition codes, Single parity check codes, Reed Muller codes, Bounds on size of codes: Hamming bound, Singleton bound, Plot kin bound, Gilbert-Varshamov bound.		
At the end of the Module 2, students will be able to: <ul style="list-style-type: none"> 1. Apply the source encoding algorithms. (BL-3) 2. Understand various codes (BL-2) 3. Analyze various bound techniques. (BL-4) 		
MODULE-3	CONVOLUTIONAL ENCODER	10Hr
Introduction to convolutional codes-I: Encoding, state diagram, trellis diagram, Introduction to convolutional codes-II: Classification, realization, distance properties.		
At the end of the Module 3, students will be able to: <ul style="list-style-type: none"> 1. Understand the convolutional codes (BL-2) 2. Understand state and trellis diagram (BL-2) 3. Find distance properties. (BL-1) 		
MODULE-4	COVOLUTIONAL DECODER	10Hr
Decoding of convolutional codes-I: Viterbi algorithm and BCJR algorithm, Performance bounds for convolutional codes, Low density parity check codes, Decoding of low density parity check codes: Belief propagation algorithm on BSC and AWGN channels.		
At the end of the Module 4, students will be able to: <ul style="list-style-type: none"> 1. Understand the decoding (BL-2) 2. Analyze the performance bounds for convolutional codes(BL-4) 3. Understand the propagation algorithms(BL-2) 		
MODULE-5	TURBO CODER	9Hr
Turbo codes, Turbo decoding, Distance properties of turbo codes, Convergence of turbo codes, Automatic repeat request schemes, Applications of linear codes.		
At the end of the Module 5, students will be able to: <ul style="list-style-type: none"> 1. Analyze turbo codes. (BL-4) 2. Understand distance properties of turbo codes. (BL-2) 3. Explain applications of linear codes (BL-2) 		
Total hours:		48 hours

Text Book(s):

1. "Error Control Coding", by Shu Lin and Daniel J. Costello, Jr., second edition, Prentice Hall, 2004.
2. Todd K. Moon, "Error Correction Coding", 1st Edition, Wiley-Inter science, 2006.
3. F. J. Mac Williams, N. J. A. Sloane, "The Theory of Error-Correcting Codes", North-Holland, Amsterdam, 1977

Reference Book(s):

1. R. E. Blahut, "Algebraic Codes for Data Transmission", 1st Edition, Cambridge University Press 2003.
2. Cary W. Huffman, Vera Pless, "Fundamentals of Error-Correcting Codes", 1st Edition, Cambridge University Press, 2003.
3. Rolf Johannesson and Kamil Sh. Zigangirov, "Fundamentals of Convolutional Coding", IEEE Press, 1999.

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4002	INDUSTRIAL ELECTRONICS							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisite: Courses on Basic Engineering Physics, Basic Electronic Devices & Power electronics.								
•								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the characteristics of Industrial electronic devices .(BL-02)							
CO 2	Explain the operation and applications of SCR.(BL-02)							
CO 3	Explain the operation and applications of Thyristor .(BL-02)							
CO 4	Explain the working principle and applications of power convertors .(BL-02)							
CO 5	Explain the working principle of timers, induction heating dielectric heating equipment .(BL-01)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1									1	2	
CO2	3	2	1									1	2	
CO3	2	3	2									1	2	
CO4	3	2	2	1								1	2	
CO5	3	2	2	1								1	2	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Industrial electronic devices	10hrs
Industrial electronics devices : SCR, DIAC, TRIAC, PUT, IGBT, Triggering methods of SCR, Commutation techniques of SCR, Opto electronic devices: Opto-Isolators, Opto-TRIAC, Opto-SCR, Opto-transistor.		
MODULE -2	SCR & its applications	10hrs
SCR: Principles of operation and characteristics of SCR, Ratings of SCR. Applications of SCR in Power Control: Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave. DIAC, TRIAC.		
MODULE-3	Thyristor & its applications	8hrs
Thyristor: Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F. Thyristor Applications: Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.		

MODULE-4	Power Converters	9hrs
Single phase rectifiers and Polyphase rectifiers, Three-phase H.W. & Three-phase F.W. rectifiers, Inverters: Series, Parallel and bridge Inverters, Inverters: Series, Parallel and bridge Inverters, Chopper, UPS : online & offline SMPS.		
MODULE-5	Industrial Applications	11 hrs
Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators. Electric Welding Classification, types and methods of Resistance and ARC welding, High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle and Applications & Ultrasonics.		
		Total hours: 48 hours

Term work:

1. Design of Surge protects with practical approach
2. List the different high frequency heating industrial application related circuits properties.

Content beyond syllabus:

1. Application of Microcontroller to Power Electronics Converter

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	Industrial electronic devices	CO1	https://www.youtube.com/watch?v=Z2CORFayCv0&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=3
2	SCR & its applications	CO2	https://www.youtube.com/watch?v=no1hld5JcCw&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=4
3	Thyristor & its applications	CO3	https://nptel.ac.in/courses/108/105/108105066/
4	Power Converters	CO4	https://nptel.ac.in/courses/108/108/108108035/
5	Industrial Applications	CO5	https://youtu.be/Iqqqxqh3QNg https://www.youtube.com/watch?v=f6Ov1KKZ_74 https://www.youtube.com/watch?v=vopAJLuHwJY

Text Books:

1. G. K. Mithal, "Industrial Electronics", Khanna Publishers, Delhi, 2000.
2. J.Gnanavadivel, R.Dhanasekaran, P.Maruthupandi, "Industrial Electronics", Anuradha Publications, 2011.

Reference Books:

1. F. D. Petruzulla, "Industrial Electronics", McGraw Hill, Singapore, 1996.
2. M. H. Rashid, "power Electronics Circuits, Devices and Application", PHI, 3rd edition, 2004.

3. G. M. Chute and R. D. Chute, "Electronics in Industry", McGraw Hill Ltd, Tokyo, 1995.

Online Resources:

1. https://www.youtube.com/watch?v=ViIomXnoEC0&list=PLm_MSCIsnwm9S8ZZEi1PUt0W1ISij4eGJ
2. <https://www.youtube.com/watch?v=Z2CORFayCv0&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=3>
3. <https://www.youtube.com/watch?v=EpTKSp9611I&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&index=7>
4. <http://www.nptelvideos.in/2012/11/industrial-drives-power-electronics.html>

Web References:

1. <https://www.sciencedirect.com/topics/engineering/industrial-electronics>
2. https://study.com/articles/Industrial_Electronics_Career_Information_and_Requirements.html
3. <https://deltauniv.edu.eg/new/engineering/wp-content/uploads/applied-industrial-chapter-1.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4003	MATLAB PROGRAMMING FOR NUMERICAL COMPUTATION							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisite: Basic Knowledge in Programming								
Course Objectives:								
1. To Understand the MATLAB programming environment								
2. To recall numerical differentiation and integration								
3. To understand linear algebra in MATLAB								
4. To explain various regression and interpolation methods.								
5. To Understand ODE								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Understand MATLAB programming(BL-2)							
CO 2	Apply trapezoidal rule MATLAB functions(BL-3)							
CO 3	Understand linear and non linear equations(BL-2)							
CO 4	Explain interpolation in MATLAB(BL-2)							
CO 5	Analyze error methods.(BL-4)							

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1											1	1
CO2	3	3	2		1								2	1
CO3	3	3	2		1								2	1
CO4	3	2	2		1								2	1
CO5	3	2	2		1								2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE -1	Introduction to MATLAB Programming	9hrs
<p>Basics of MATLAB programming, Array operations in MATLAB, Loops and execution control Working with files: Scripts and Functions Plotting and program output.</p> <p>Approximations and Errors: Defining errors and precision in numerical methods Truncation and round-off errors, Error propagation, Global and local truncation errors.</p> <p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> 1. Illustrate MATLAB Programming Environment (BL-2) 2. Explain array operations in Matlab (BL-2) 3. Describe global and local truncation errors(BL-2) 		
MODULE -2	Numerical differentiation and integration	9 hrs
<p>Numerical Differentiation in single variable, Numerical differentiation: Higher derivatives, Differentiation in multiple variables, Newton-Cotes integration formulae, Multi-step application of Trapezoidal rule MATLAB functions for integration.</p>		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Explain numerical differentiation(BL-2) 2. Illustrate differentiation in multiple variables(BL-2) 3. Explain newton cotes integration formulae(BL-2) 		
MODULE-3	Linear equations and Non linear equations	10hrs
Linear algebra in MATLAB, Gauss Elimination LU decomposition and partial pivoting Iterative methods: Gauss-Siedel Special Matrices: Tri-diagonal matrix algorithm Nonlinear equations in single variable, MATLAB function zero in single variable, Fixed-point iteration in single variable, Newton-Raphson in single variable, MATLAB function solve in single and multiple variables Newton-Raphson in multiple variables.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain linear algebra in MATLAB(BL-2) 2. Describe LU decomposition and partial pivoting iterative methods(BL-2) 3. Describe Newton-Raphson in multiple variables(BL-2) 		
MODULE-4	Regression and Interpolation	10hrs
Introduction, linear least squares regression(including lsqcurvefit function), Functional and nonlinear regression (including lsqnonlin function), Interpolation in MATLAB using spline and p-chip.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain linear least squares regression(BL-2) 2. Illustrate functional regressions(BL-2) 3. Describe interpolation method in MATLAB(BL-2) 		
MODULE-5	Ordinary differential equations(ODE)	10hrs
Introduction to ODEs; Implicit and explicit Euler's methods, Second-Order Runge-Kutta Methods, MATLAB ode45 algorithm in single variable, Higher order Runge-Kutta methods , Error analysis of Runge-Kutta method.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain ODE basics(BL-2) 2. Illustrate ODE 45 algorithm in MATLAB (BL-2) 3. Illustrate hgher order runge- kutta methods(BL-2) 		
Total hours:		45 hours

Term work:			
Develop Graphical user interface (GUI) Environment to handle Image processing functions like image display, image filtering, image edge detection of Given image			
Content beyond syllabus:			
1. Advanced graphics using MATLAB			
Self-Study:			
Contents to promote self-Learning:			
SN	Topic	Reference	
O			

1	Introduction to MATLAB	https://www.mathworks.com/academia/highschool/courseware/introduction-to-matlab.html https://www.geeksforgeeks.org/introduction-to-matlab/		
2	Arrays:	https://www.mathworks.com/help/matlabmobile/ug/creating-matrices-and-arrays.html https://www.lehigh.edu/~ineng2/clipper/notes/MATLABenteringArrays.htm		
3	Functions and Files :	https://www.mathworks.com/help/matlab/matlab_prog/create-functions-in-files.html http://matlab.izmiran.ru/help/techdoc/matlab_prog/ch05_m13.html		
4	Programming Techniques:	https://www.mathworks.com/help/matlab/programming-and-data-types.html https://en.wikibooks.org/wiki/MATLAB_Programming		
5	Plotting & Simulink	https://www.mathworks.com/help/matlab/creating_plots/types-of-matlab-plots.html https://www.mathworks.com/products/simulink.html https://www.mathworks.com/discovery/matlab-gui.html https://www.youtube.com/watch?v=a_DW7xznPco		
6	Image Processing with MATLAB	https://www.electronicsforu.com/electronics-projects/image-processing-using-matlab-part-1 https://circuitdigest.com/tutorial/getting-started-with-image-processing-using-matlab		

Text Book(s):

1. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson Education

References:

2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed., McGraw Hill

Online Resources:

1. <http://www.netlib.org/na-digest-html>
2. <http://www.mathworks.com/matlabcentral/>
3. <https://www.tutorialspoint.com/matlab/index.htm>

Web References:

1. <https://nptel.ac.in/courses/103/106/103106074/>
2. <https://idoc.pub/documents/stormy-attaway-matlab-a-practical-introduction-to-programming-and-problem-solvingpdf-vnd59g5eewlx>

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4004	Fundamentals of Micro and Nano Fabrication							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisite: Micro and nano systems								
Course Objectives:								
1.Explain various cleaning methods								
2. Analyze various deposition methods								
3. Learn optical lithography								
4. Differentiate wet and dry etching								
5. Describe tool and process								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Describe various cleaning techniques (BL_4)							
CO 2	Explain various deposition methods(BL-2)							
CO 3	Understand optical lithography(BL-2)							
CO 4	Analyze wet and dry etching (BL-4)							
CO 5	Understand design for manufacturability (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	1	2					1					1	1
CO2	3	1	2					1						
CO3	3	2	1				1						1	
CO4	3	1	2					2						
CO5	3	1	1		1			12						

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO MICRO FABRICATION	10 Hrs
Substrate, Introduction to clean room, Additive Processing: Contamination and surface cleaning, Advanced cleaning techniques, Defects, Diffusion, Diffusion -Advanced Concepts, Ion Implantation.		
At the end of the Module 1, students will be able to:		
1. Understand micro fabrication basics (BL-2)		
2. Explain contamination and surface cleaning(BL-2)		
3. Analyze various cleaning techniques (BL-4)		
MODULE -2	ADDITIVE PROCESSING	9 Hrs
Native films, Advanced Concepts, Defects at Si/SiO2 interface, Chemical Vapor Deposition, Material deposition-ALD & Physical Vapor Deposition, Atomic Layer Deposition, Physical Vapor Deposition: Basics, Evaporation, and Sputtering.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Identify defects at Si/SiO₂ interface (BL-1) 2. Explain various deposition methods (BL-2) 		
MODULE-3	METALLIZATION AND OPTICAL LITHOGRAPHY	10 Hrs
Metallization and Optical Lithography: Contact resistance, Electro-migration and Epilogue, Pattern Transfer Basics, Optical lithography basics: resist process, Contact and Proximity printing, Stepper and Scanner, Image formation basics, Image formation in photo resist, Surface Reflection.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Understand metallization (BL-2) 2. Understand optical lithography (BL-2) 3. Explain contact and proximity printing (BL-2) 		
MODULE-4	WET & DRY ETCHING	10 Hrs
Etching ,Figures of Merit, Wet etching Basics, Wet Etching Recipes, Optical Lithography & E-Beam Lithography, Mask Technology, Dry etch: Plasma, Basics Plasma etching basics, Plasma tool configuration, Etch mechanism, Etch chemistry.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Differentiate wet and dry etching (BL-4) 2. Recall optical lithography methods(BL-2) 3. Understand plasma etching basics(BL-2) 		
MODULE-5	CHEMICAL MECHANICAL POLISH AND DESIGN FOR MANUFACTURABILITY	9 Hrs
Basics, Tool and process, Design for Manufacturability, Process integration, PV integration, CMOS integration.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Describe tool and process (BL-2) 2. Understand design for manufacturability (BL-2) 3. Differentiate various integration methods (BL-4) 		
		Total hours: 48 hours

Term work:			
1.			
Content beyond syllabus:			
Molecular beam epitaxy			
Self-Study:			
Contents to promote self-Learning:			
SNO	Topic	CO	Reference

1	Introduction to micro fabrication	CO1	https://www.wiley.com/en-us/Introduction+to+Microfabrication,+2nd+Edition-p-9780470749838
2	Chemical vapour deposition	CO2	https://www.nature.com/articles/s43586-020-00005-y
3	Optical lithography	CO3	https://www.sciencedirect.com/topics/engineering/optical-lithography
4	E beam lithography	CO4	https://en.wikipedia.org/wiki/Electron-beam_lithography
5	Pv integration and solar integration	CO5	https://www.researchgate.net/publication/241514674_Integration_of_solar_cells_on_top_of_CMOS_chips_part_I_A-Si_solar_cells

Text Book(s):

1. Stephen A. Campbell (1996), The Science and Engineering of Microelectronic Fabrication, Oxford university Press.
2. Sorab K. Gandhi (1994), VLSI Fabrication Principles: Silicon and Gallium Arsenide, Wiley.
3. Richard C. Jaeger (2001), Introduction to Microelectronic Fabrication, Modular Series on Solid State Devices

Reference Book(s):

1. Milton Ohring (2002), Materials Science of Thin Films, Deposition and Structure
2. Marc J. Madou (2011) Fundamentals of Microfabrication and Nanotechnology, CRC Press.
3. Chris Mack (2007), Fundamental Principles of Optical Lithography, Wiley.

Online Resources:

- 1 <https://www.wiley.com/en-us/Introduction+to+Microfabrication,+2nd+Edition-p-9780470749838>
- 2 <https://www.youtube.com/watch?v=IW0QMvmeVGs&list=PLgMDNELGJ1CbHti4HN0BuagtoD06H78YT>

Web References:

1. <https://www.youtube.com/watch?v=6yB5xg97Bjc&list=PLgMDNELGJ1CbHti4HN0BuagtoD06H78YT&index=3>
2. <https://www.youtube.com/watch?v=IkUR2Zk9qXY>

NARAYANA ENGINEERING COLLEGE:GUDUR

20EC4005	SEMICONDUCTOR MEMORIES							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

Pre-requisite: Basic knowledge on memories & CMOS technology.

Course Objectives:

1. To understand the design and architecture of MOS memories.
2. To understand the design and architecture of non volatile memories.
3. To apply various testing methods on semiconductor memories.
4. To illustrate the concept of reliability of semiconductors.
5. To analyse Radiation Hardening Techniques of semiconductors.

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

CO 1	Understand the design and architecture of MOS memories.(BL-2)
CO 2	Explain the design and architecture of non volatile memories.(BL-2)
CO 3	Apply various testing methods on semiconductor memories. (BL-3)
CO 4	Explain the reliability of semiconductors & Radiation Hardening Techniques (BL-2)
CO 5	Understand the architecture of advanced memory technologies.(BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	CO1	3	2	1										1
CO2	2		1										1	
CO3	2	2		2										1
CO4	2	1	2	2									1	
CO5	2	2	1											

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE -1	SRAM AND DRAM MEMORIES	10 hrs
<p>SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar SRAM Technologies-Silicon On Insulator (SOI) Technology-Advanced SRAM Architectures and Technologies-Application Specific SRAMs. DRAM Technology Development-CMOS DRAMs - DRAMs Cell Theory and Advanced Cell Structures' - BiCMOS, DRAMs - Soft Error Failures in DRAMs - Advanced DRAM Designs and Architecture-Application Specific DRAMs.</p>		
<p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the architecture of MOS SRAM cell. (BL-2) 2. Understand the architecture of MOS DRAM cell. (BL-2) 3. Compare architectural features of SRAM & DRAM cells. (BL-2) 		
MODULE -2	NON VOLATILE MEMORIES	10hrs
<p>Masked Read-Only Memories (ROMs)-High Density ROMs-Programmable Read-Only Memories (PROMs)-BipolarPROMs-CMOS PROMs-Erasable (UV) - Programmable Road-Only Memories (EPROMs)-Floating-Gate EPROM Cell-One-Time Programmable (OTP) EPROMs Electrically Erasable PROMs (EEPROMs)-EEPROM Technology And Architecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture.</p>		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the architecture of Masked Read-Only Memories. (BL-2) 2. Understand the architecture of bipolar PROMS. (BL-2) 3. Compare various non volatile memories. (BL-2) 		
MODULE-3	MEMORY FAULT MODELLING & TESTING	8 hrs
RAM Fault Modelling, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing, Non-volatile Memory Modelling and Testing-IDDQ Fault Modelling and Testing-Application Specific Memory Testing.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the concept of RAM Fault Modelling. (BL-2) 2. Understand the concept of Non-volatile Memory Modelling. (BL-2) 3. Apply various testing methods on semiconductor memories. (BL-3) 		
MODULE-4	MEMORY RELIABILITY AND RADIATION EFFECTS	11 hrs
General Reliability Issues-RAM Failure Modes and Mechanism-Non-volatile Memory Reliability-Reliability Modelling and Failure Rate Prediction-Design for Reliability-Reliability Test Structures-Reliability Screening and Qualification.		
Single Event Phenomenon (SEP)-Radiation Hardening Techniques-Radiation Hardening Process and Design Issues-Radiation Hardened Memory Characteristics-Radiation Hardness Assurance and Testing -Radiation Dosimetry-Water Level Radiation Testing and Test Structures.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate the concept of reliability of semiconductors. (BL-2) 2. Understand Reliability Test Structures of semiconductors. (BL-2) 3. Understand the Radiation Hardening Process for semiconductor memories. (BL-2) 4. Analyse Radiation Hardening Techniques of semiconductors. (BL-4) 		
MODULE-5	ADVANCED MEMORY TECHNOLOGIES	9 hrs
Ferroelectric Random Access Memories (FRAMs)-Gallium Arsenide (GaAs) FRAMs - Analog Memories-Magneto-resistive Random Access Memories (MRAMs)-Experimental Memory Devices. Memory Hybrids and MCMs (2D)-Memory Stacks and MCMs (3D)-Memory MCM Testing and Reliability Issues-Memory Cards-High Density Memory Packaging Future Directions.		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the architecture of Gallium Arsenide (GaAs) FRAM. (BL-2) 2. Understand the architecture of Magneto-resistive Random Access Memories (MRAM). (BL-2) 3. Compare FRAM with MRAM. (BL-2) 		
Total hours:		48 hours

Term work:		
Content beyond syllabus: Architecture of Flash memory		
Self-Study: Contents to promote self-Learning:		
SN	Topic	Reference
O		

1	SRAM Cell	http://lumerink.com/courses/ece515/Handouts/SRAM%20Architecture.pdf
2	Non volatile memories	https://www.geeksforgeeks.org/classification-and-programming-of-read-only-memory-rom/
3	Memory fault modelling & testing	https://www.edn.com/memory-fault-models-and-testing/
4	RAM failure modes & mechanisms	https://www.tebodin.bilfinger.com/fileadmin/tebodin/Area_Middle_East/Articles/Services_-_RAM_study.pdf
5	Radiation hardening techniques	http://facta.junis.ni.ac.rs/eae/fu2k142/eae140206.pdf
6	FRAM	https://www.electronics-notes.com/articles/electronic_components/semiconductor-ic-memory/fram-ferroelectric-ram-memory.php

Text Book(s):

1. Ashok K. Sharma, "Semiconductor Memories", Two-Volume Set, Wiley-IEEE Press, 2003.
2. Brent Keeth, R. Jacob Baker, Brian Johnson, Freng Lin, "DRAM Circuit Design : Fundamental and High Speed Topics", Wiley-IEEE Press, 2nd Edition, 2008.
3. Betty Prince, "High Performance Memories: New Architecture DRAMs and SRAMs - Evolution and Function", Wiley, Revised Edition, 1999.

Reference Book(s):

1. Luecke Mize Care, " Semiconductor Memory design & application", Mc-Graw Hill.
2. Memory Technology design and testing 1999 IEEE International Workshop on: IEEE Computer Society Sponsor (S)
3. Bely Prince, " Semiconductor Memory Design Handbook"

Online Resources:

1. <https://nptel.ac.in/courses/117/101/117101058/>
2. https://www.youtube.com/watch?v=I-9XWtdW_Co

Web References:

1. <http://www.mpedram.com/Papers/Two-LowPower-SRAM-cells-TVLSI.pdf>
2. <http://user.engineering.uiowa.edu/~vlsi1/notes/lect19-sram-dcm.pdf>
3. <https://nptel.ac.in/content/storage2/courses/117101058/downloads/Lec-27.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4006	PROGRAMMABLE LOGIC CONTROLLERS							R2021
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100
Pre-requisite: Electrical& Electronics basics,Industrial controls								
Course Objectives:								
<ol style="list-style-type: none"> 1. It is to provide and ensure a comprehensive understanding of using advanced controllers in measurement and control instrumentation. 2. To illustrate about data acquisition – process of collecting information from field instruments. 3. To analyse Programmable Logic Controller (PLC), IO Modules and internal features. 4. To Comprehend Programming in Ladder Logic, addressing of IO. 5. To understand the significance of PID in industrial applications. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain main functional units in a PLC and their interaction.(BL-2)							
CO 2	Construct basic Ladder logic diagrams for the circuits .(BL-3)							
CO 3	Illustrate the working principles of Registers, timers and counters and their real time applications.(BL-2)							
CO 4	Explain data handling functions of PLC.(BL-2)							
CO 5	Demonstrate analog signal processing and PID operations.(BL-2) Illustrate PLC applications.(BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												2	
CO2	2	2	2									2	2	
CO3	2	2											2	
CO4	2												2	
CO5	2												2	
: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Introduction to PLC	8h
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.		
At the end of the Module 1, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain fundamentals of PLC system. (BL-2) ▪ List the devices connected to PLC modules.(BL-1) ▪ Explain the I/O modules. (BL-2) 		
MODULE -2	PLC Programming	10h
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings		

At the end of the Module 2, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain the basics of PLC programming. (BL-2) ▪ Model industrial applications using PLC. (BL-3) ▪ Solve boolean expressions using ladder logic. (BL-3) 		
MODULE-3	PLC Registers	10h
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Number comparison functions, number conversion functions.		
At the end of the Module 3, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain PLC registers. (BL-2) ▪ Explain Timer functions and its industrial application. (BL-2) ▪ Explain counter functions and its industrial application. (BL-2) 		
MODULE-4	PLC Functions	10h
Arithmetic Functions, Data move functions,SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, Matrix functions.		
At the end of the Module 4, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain arithmetic functions. (BL-2) ▪ List PLC functions. (BL-1) ▪ Explain sequencer functions. (BL-2) 		
MODULE-5	Analog PLC operation	10h
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules(5h) Controlling of Robot using PLC, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating.(5)		
At the end of the Module 5, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain Analog PLC operation. (BL-2) ▪ Explain PID functions. (BL-2) ▪ List the advantages of PID. (BL-1) ▪ Summarize the PLC applications. (BL-2) ▪ Explain industrial applications of PLC. (BL-2) ▪ Explain manufacturing applications of PLC. (BL-2) 		
		Total hours:48 hours

<p>Term work:</p> <p>Using a virtual PLC simulator construct the following ladder programs.</p> <ol style="list-style-type: none"> 1.Verification of Logic Gates. 2.Verification of Timer functions. 3.Verification of Counter functions.
<p>Content beyond syllabus:</p> <ol style="list-style-type: none"> 1. IIOT 2.Advanced Field Bus Technology.
<p>Self-Study:</p> <p>Contents to promote self-Learning:</p>

S NO	Topic	CO	Reference
1	PLC	CO1	https://nptel.ac.in/courses/108/105/108105062/
2	Ladder Programs	CO2	https://nptel.ac.in/courses/108/105/108105062/
3	Registers of PLC	CO3	https://grieteee1317.files.wordpress.com/2017/05/unit-iii-plc-registers-and-functions.pdf
4	Arithmetic Functions	CO4	https://www.slideshare.net/srtu99ler/12-arithmetic-functions
5	Analog PLC Operation	CO5	https://www.plcademy.com/plc-analog-input-output/

Text Book(s):

1. Programmable Logic Controllers – Principle and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI
2. Digital Design by Morris Mano, PHI, 3rd Edition 2006.
3. Programmable logic Controllers, Frank D. Petruzella, 4th Edition, McGraw Hill Publishers.

Reference Book(s):

1. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth & F.D Hackworth Jr. – Pearson, 2004.
2. Programmable logic controllers and their Engineering Applications, 2nd Edition, Alan J. Crispin.
3. Computer Control of Process, S.K. Singh

Online Resources:

1. https://www.nfiautomation.org/FREE_Download/Technical%20Documents/PLC/%28eBook%29%20%20PLC%20Programming%20Methods.pdf

Web Resources:

1. <https://nptel.ac.in/courses/108/105/108105062/>
2. http://www.ieec.uned.es/investigacion/Dipseil/PAC/archivos/introtopics_SUPER.pdf
3. [https://instrumentationtools.com > tag > plc-basics-nptel](https://instrumentationtools.com/tag/plc-basics-nptel)
4. <https://onlinecourses.nptel.ac.in>
5. [https://instrumentationtools.com > tag > plc-ladder-logic-nptel](https://instrumentationtools.com/tag/plc-ladder-logic-nptel)
6. [https://onlinecourses.nptel.ac.in > noc21_me67 > preview](https://onlinecourses.nptel.ac.in/noc21_me67/preview)

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4007	ANTENNAS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VI	3	0	0	48	3	40	60	100
Pre-requisites:								
<ul style="list-style-type: none"> ✓ Knowledge of Mathematics is essential ✓ Basics concepts of Electromagnetics ✓ Basics of Vector Analysis ✓ Electromagnetic waves and transmission lines 								
Course Objectives:								
<ol style="list-style-type: none"> 1. To introduce radiation mechanisms and basic characteristics of antennas. 2. To derive mathematical expressions and their application for complete design of antennas. 3. To explain measurement of antenna parameters 4. To introduce design concepts of various types of antennas including micro strip antenna. 5. To describe binomial arrays 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the construction & radiation pattern of antenna(BL:2)							
CO 2	Analyze the radiation resistance & patterns of Loop, Yagi-uda array, Folded Dipole, Helical & Horn antennas (BL:3)							
CO 3	Analyze the radiation resistance & patterns of Micro strip and reflector antennas.(BL:3)							
CO 4	Analyze the antenna arrays. (BL:3)							
CO 5	Discuss the techniques to measure the radiation pattern, directivity and gain of antennas.BL:2)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2									2		
CO2	3	3	3	2								2	3	3
CO3	3	3	3	2								2	3	3
CO4	3	3	3	2								2	3	3
CO5	3	3	2									2	3	3

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	ANTENNA BASICS	Hours:08
Antenna parameters: Radiation pattern, Radiation intensity, Beam area, Beam efficiency, Beam width, Antenna efficiency, Gain, Directivity, Effective area, Effective height, Polarization, Antenna temperature, Antenna impedance, Front to back ratio, Applicability of network theorems to antennas, Radiation from		

quarter wave monopole and Half wave dipole, Illustrative Problems.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the applications of reciprocity theorem for antennas. 2. Describe various antenna parameters. 3. Explain different types of antennas. 		
MODULE -2	VHF,UHF & MICROWAVE ANTENNAS-I	Hours:10
Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Antennas, Folded Dipoles & their characteristics, Slot Antennas and their characteristics, Log-Periodic Antennas, Illustrative Problems.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1.Explain the construction and working of Yagi-uda antenna. 2.Derive the radiation resistance of dipole antenna. 3.Derive the expression for the radiation resistance and directivity of a loop antenna. 		
MODULE-3	VHF,UHF & MICROWAVE ANTENNAS-II	Hours:10
Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, reflector antennas - Introduction, Flat sheet and corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning , Tolerances, Applications, Illustrative Problems.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the corner reflector antennas and its design considerations. 2. Differentiate active & passive corner reflectors. 3. Explain the basic principle of operation of lens antenna. 4. Explain the basic characteristics of microstrip antennas. 		
MODULE-4	HELICAL AND HORN ANTENNA	Hours:10
Helical Antennas- Helical Geometry, Helix modes, Practical Design considerations for Mono-filar Helical Antenna in Axial and Normal Modes. Horn Antennas- Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Illustrative Problems.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the modes of operation of helical antenna. 2. Explain the construction and characteristics of helical antenna. 3. Explain the construction and working of Horn antenna. 		
MODULE-5	ANTENNA ARRAYS AND MEASUREMENTS	Hours:10
Introduction, Arrays of two Isotropic point sources-different cases, Principle of pattern multiplication, N-element uniform linear array- Broadside and end fire cases, Properties of BSA & EFA, EFA with increased directivity, Binomial array, Illustrative Problems.		
Antenna Measurements: Introduction, near and far fields, sources of errors, Gain measurement-Gain comparison and absolute gain methods, Radiation Pattern and Directivity measurement.		

At the end of the Module 5, students will be able to:

1. Compare BSA and End fire array.
2. Explain Binomial arrays.
3. Analyze principle of pattern multiplication

Term work:

- Measurement of antenna parameters.

Content beyond syllabus:

Recent Advances in Antenna Design for 5G Heterogeneous Networks.

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	Introduction to antennas	CO1	https://youtu.be/bIKFmJn7wH0
2	Definition and types of antenna arrays	CO5	https://youtu.be/95MfBLjrHsU
3	Binomial Arrays	CO5	https://youtu.be/3PMWI5euriE
4	Yagi-Uda array	CO2	https://youtu.be/yCJ7cN2G73g
5	Horn antenna definition, construction, operation	CO4	https://youtu.be/tmHjb71Rt48
6	Feed mechanisms for reflector antennas	CO3	https://youtu.be/4vtz2AhBZJE

Text Book(s):

1. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, "Antennas and wave propagation," TMH, New Delhi, 4th Ed., (special Indian Edition), 2010.
2. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems," PHI, 2ndEdn, 2000.

Reference Book(s):

1. C.A. Balanis, "Antenna Theory- Analysis and Design," John Wiley & Sons, 2ndEdn., 2001.
2. K.D. Prasad, SatyaPrakashan, "Antennas and Wave Propagation," Tech. India Publications, New Delhi, 2001.

Online Resources:

1. www.eng.auburn.edu/~mikeb/Antennas/Antennas.ppt
2. <https://www.slideshare.net/DrSSanthiProfessor/yagi-uda-antenna>
3. <https://www.slideshare.net/physicsImpossible/helical-antenna>
4. <https://www.slideshare.net/charan10/microstrip-rectangular-patch-antenna-58000257>
5. <https://www.slideshare.net/RomaRicoFlores/lens-antenna>

Web References:

1. https://www.youtube.com/watch?v=wx_tIvaajAI
2. <https://nptel.ac.in/courses/117101056/23>
3. <https://nptel.ac.in/courses/108101092/40>
4. <https://nptel.ac.in/courses/108101092/Week-10-Horn-Antennas-Part-1.pdf>
5. <https://nptel.ac.in/courses/108101092/59>

NARAYANA ENGINEERING COLLEGE:GUDUR														
20EC4008	MICRO ELECTRONICS :DEIVCES TO CIRCUITS							R2020						
Semester	Hours / Week			Total hrs	Credit	Max Marks								
	L	T	P			C	CIE	SEE	TOTAL					
VI	3	0	0	48	3	40	60	100						
Module 1	Module 2	Module 3	Module 4	Module 5	Total									
8H	10H	10H	10H	10H	48H									
Pre-requisite: knowledge on semiconductor materials														
Course Objectives:														
<ul style="list-style-type: none"> • Be familiar with the MOSFET physical structure and operation, terminal characteristics, circuit models and basic circuit applications. • Confront integrated device and/or circuit design problems, identify the design issues, and develop solutions. • Analyze and design microelectronic circuits for linear amplifier and digital applications. • Contrast the input/output and gain characteristics of single-transistor, differential and common two-transistor linear amplifier building block stages • Provide solutions to overcome short channel effects. 														
Course Outcomes: After successful completion of the course, the student will be able to:														
CO 1	Explain various characteristics MOSFETs.(BL-02)													
CO 2	Analyze the frequency response of MOSFET amplifiers .(BL-02)													
CO 3	Design Single stage amplifiers to meet stated operating specifications using MOS Transistors. (BL-0 3)													
CO 4	Design Differential amplifiers to meet stated operating specifications.(BL-03)													
CO 5	Explain Multistage amplifiers and their frequency responses.(BL-02)													
CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	2	2	1		2							1	1	
CO2	2	2	1		1							1	2	2
CO3	2	3	2		1							1	1	
CO4	2	2	2	1	1							1		1
CO5	2	2	2	1								1	1	
CO6	3	3	2	1	2							1		2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE-1	MOSFET	8H
MOS Capacitors: Energy levels and flat band, Static and Biased band shapes, Accumulation, depletion and inversion, NMOS and PMOS, Quantitative solution, Fields and Potentials MOS Transistor: Qualitative description, Triode regime, Pinch-off and saturations regime, Quantitative derivation, Threshold voltage, Square Law, MOSFET as an amplifier and as a switch,		

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. List the types of MOSFET. (BL-01) 2. Demonstrate the MOSFET device structure. (BL-02) 3. Explain the characteristics of MOSFET.(BL-02) 4. Understand the pinch off and saturation regime of MOS transistor .(BL-02) 		
MODULE-2	MOSFET Biasing	10H
Biasing in MOS amplifier Circuits, Small Signal Operation and Models, Basic MOSFET amplifier, MOSFET internal capacitances, frequency response of CS amplifier.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Define MOSFET biasing. (BL-01) 2. Explain small signal operation of MOSFET. (BL-02) 3. Explain internal capacitances of MOSFET.(BL-02) 4. Understand the frequency response of CS amplifier.(BL-02) 		
MODULE-3	Single Stage IC Amplifier	10H
Comparison of MOSFET and BJT, Current sources, Current mirrors and Current steering circuits, high frequency response- general considerations, CS with active loads, high frequency response of CS, CG amplifiers with active loads, high frequency response of CG, Cascode amplifiers. CS with source degeneration.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Apply the knowledge of semiconductors to illustrate the functioning of BJT. (BL-02) 2. Analyze the DC performance of single-stage analog amplifiers containing these circuit elements 3. Analyze the Various configurations in terms of frequency response. (BL-04) 4. Identify active, cut off and saturation regions of a transistor. (BL-01) 5. Explain working of cascode amplifiers.(BL-02) 		
MODULE-4	Differential Amplifiers	10H
The MOS differential pair, small signal operation of MOS differential pair, Differential amplifier with active loads, and frequency response of the differential amplifiers.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the differential pair of MOSFET. (BL-03) 2. Explain the operation of small signal differential amplifier pair. (BL-02) 3. Understand the differential amplifier with active loads. (BL-02) 		
MODULE-5	Multistage Amplifiers	10H
Configurations, Cascaded stages, DC equivalent, AC equivalent and small signal, Gain and I/O resistance. Scaling of MOSFETs: Short channel MOSFETs – short channel effects, velocity saturation, channel, length modulation, DIBL, GIDL. Variability in MOSFETs.Reliability of MOSFETs high field effects, hot carrier degradation, negative bias temperature instability, MOSFET breakdown, high k dielectrics.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Define various configurations of multistage amplifiers.(BL-01) 2. Explain the DC performance of multistage amplifiers.(BL-02) 3. Understand the AC equivalent performance of multistage amplifiers.(BL-02) 		
Term work:		
<ol style="list-style-type: none"> 1. Develop plans and circuits for prototypes of electronic circuits, chips, circuit boards and semiconductors. 2. Apply knowledge of mechanical systems, new materials, and electronics to construct prototypes of new designs. 		
Content beyond syllabus:		
<ol style="list-style-type: none"> 1. The circuits properties of biastable latch 		

2. Applications of counters

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	MOSFETs	https://www.youtube.com/watch?v=pNxOXXvPsng&list=PLF178600D851B098F&index=33 https://www.youtube.com/watch?v=lrbGAgrcvic&list=PLF178600D851B098F&index=38
2	MOSFET Biasing	https://www.youtube.com/watch?v=-Aomrix0CGE https://www.youtube.com/watch?v=x6sj8dq1XJI&t=2730s
3	Single Stage IC Amplifier	https://www.youtube.com/watch?v=UdLPu-7Mwrw
4	Differential Amplifiers	https://www.youtube.com/watch?v=hwEa50roJDM
5	Multistage Amplifiers	https://www.youtube.com/watch?v=-bz6u7IF1gM https://www.youtube.com/watch?v=clTA0pONnMs&t=2158s

Text Book(s):

1. Howe, R. T., and C. G. Sodini. [Microelectronics: An Integrated Approach](#). Upper Saddle River, NJ: Prentice Hall, 1996. ISBN: 0135885183
2. Jaeger & Blalock, *Microelectronic Circuit Design* (5th edition), McGraw Hill, 2015. ISBN 9780073529608 (required)
3. *Microelectronic Circuits*, Adel Sedra and K.C. Smith, 6th Edition, Oxford University Press, International Version, 2009
4. Taur and T. H. Ning, —*Fundamentals of Modern VLSI Devices*, Cambridge University Press, Cambridge, United Kingdom, 1998.

Reference Book(s):

1. Fonstad, C. G. *Microelectronic Devices and Circuits*. New York, NY: McGraw-Hill, 1994. ISBN: 0070214964.
2. Pierret, R. F. *Semiconductor Device Fundamentals*. Upper Saddle River, NJ: Prentice Hall, 1995. ISBN: 0201543931.
3. *Microelectronics – Analysis and Design*, Sundaram Natarajan, Tata McGraw-Hill, 2007
4. A. B. Bhattacharyya, —*Compact MOSFET Models for VLSI Design*, John Wiley & Sons Inc., 2009.

Online Resources:

1. https://www.youtube.com/watch?v=366BVdmcUxk&list=PLLy_2iUCG87C-GS7B4vJ37Iz3fevmYU1h
2. https://www.youtube.com/watch?v=zbgGbiHkXE8&list=PLLy_2iUCG87CGS7B4vJ37Iz3fevmYU1h&index=28
3. <https://www.electronicsforu.com/?s=microelectronics>

Web References:

1. <https://www.pdfdrive.com/introduction-to-microelectronics-e33410165.html>
2. https://www.gfps.com/content/dam/gfps/solutions/segments/me/GF_Brochure_ME_GFDO_5990_en.pdf
3. www.mosis.com/pages/Technical/Testdata/submicron-spice-parameters

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4009	ADAPTIVE SIGNAL PROCESSING							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100
Pre-requisite: Signals and Systems, Analog and digital communication, Antenna								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand linear optimum filtering 2. To estimate phase shift between two narrow band signals 3. To search the performance surface 4. to understand adaptive beam forming 5. To examine target tracking 6. To define Kalman filtering problem 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain adaptive linear combiner (BL-1)							
CO 2	Calculate minimum mean square error (BL-4)							
CO 3	Compare leaving curves (BL-2)							
CO 4	Retrieve LMS adaptation algorithm (BL-1)							
CO 5	Estimate state using the innovation process (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	2										2	
CO2	3	3											2	
CO3	3	3											2	
CO4	3	3	2										2	
CO5	3	3	2										2	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO ADAPTIVE SYSTEMS	10 Hrs
Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner – Description, Weight Vectors, Desired Response Performance function – Gradient & Mean Square Error.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> 1. Explain characteristics of an adaptive system(BL-2) 2. Describe adaptive linear combiner (BL-1) 3. Calculate mean square error (BL-4) 		
MODULE -2	DEVELOPMENT OF ADAPTIVE FILTER THEORY	9 Hrs
Introduction to Filtering – Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally – Minimum Mean Square Error, Wiener- Hopf equations, Error Performance – Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.		

At the end of the Module 2, students will be able to:

1. Explain smoothing and prediction (BL-2)
2. Understand linear optimum filtering (BL-2)
3. Calculate minimum mean square error (BL-4)
4. Estimate phase shift between narrow band signals (BL-2)

MODULE-3	STEEPEST DESCENT ALGORITHMS	10 Hrs
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Searching the performance surface – Methods & Ideas of Gradient Search methods – Gradient Searching Algorithm & its Solution – Stability & Rate of convergence – Learning Curves Gradient Search by Newton’s Method, Method of Steepest Descent, Comparison of Learning Curves.

At the end of the Module 3, students will be able to:

1. Search the performance surface (BL-1)
2. Explain gradient searching algorithm (BL-2)
3. Compare learning curves (BL-2)

MODULE-4	LMS ALGORITHM & APPLICATIONS	10 Hrs
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Overview – LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms – LMS Gradient & Stochastic algorithms – Convergence of LMS algorithm. Applications: Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform. Introduction to MUSIC

At the end of the Module 4, students will be able to:

1. Retrieve LMS adaptation algorithms (BL-1)
2. Analyze the performance of LMS algorithms (BL-4)
3. Understand adaptive beam forming (BL-2)
4. Implement adaptive filter of Hilbert transform (BL-3)

MODULE-5	STATE ESTIMATORS	9Hrs
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Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

At the end of the Module 5, students will be able to:

1. Define Kalman filtering problem (BL-1)
2. Estimate state using the innovation process (BL-2)
3. Examine target tracking using only DOA (BL-3)

Total hours: 48 hours

Term work:

Content beyond syllabus:

Structures and algorithms for two dimensional adaptive signal processing

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Adaptive linear combiner	CO1	https://en.wikipedia.org/wiki/Adaptive_filter#:~:text=The%20adaptive%20linear%20combiner%20(ALC,would%20comprise%20an%20adaptive%20filter.
2	Adaptive filter theory	CO2	https://www.sqrt-1.dk/aboutme/publications/20120919_adapt_filt.screen.pdf
3	Steepest descent algorithm	CO3	https://nowak.ece.wisc.edu/ece830/ece830_spring13_adaptive_filtering.pdf
4	LMS algorithm	CO4	http://www.cnel.ufl.edu/courses/EEL6502/05_LMS_algorithm.pdf
5	Statement of Kalman filtering problem	CO5	https://www.intechopen.com/chapters/63164

Text Books:

1. Bernard Widrow, Samuel D. Stearns, "Adaptive Signal Processing", 2005, PE.
2. Simon Haykin, "Adaptive Filter Theory", 4th Edition. 2002, PE Asia.

Reference Book(s):

1. Sophocles. J. Orfamadis, "Optimum signal processing: An introduction", 2nd Edition, 1988, Mc Graw-Hill, Newyork
2. S. Thomas Alexander, "Adaptive signal processing-Theory and Applications", 1986, Springer.

Online Resources:

1. <https://www.youtube.com/watch?v=ya0-S1apej8&list=PLEE3BA3C8CB606B8C>
2. <https://www.youtube.com/watch?v=rNU2dSL4Yrw>
3. <https://www.youtube.com/watch?v=mwn8xhgNpFY>

Web References:

1. <https://link.springer.com/book/10.1007/978-1-4419-8658-0#toc>
2. <https://forums.ni.com/t5/Example-Code/Least-Mean-Square-LMS-Adaptive-Filter/ta-p/3996183>
3. https://course.ece.cmu.edu/~ece792/handouts/LO_Chap_AdaptiveFilters.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4010	Mixed Signal Design							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CI E	SEE	TOTAL
VI	3	0	0	48	3	40	60	100
Pre-requisite: Linear IC Applications ,VLSI Design								
Course Objectives:								
1. To Understand the concepts of Switched capacitors Circuits. 2. To Extend the concept of phase locked loop for designing PLL application with minimum jitter by considering non ideal effects. 3. To study concepts of Data Converter Fundamentals, Nyquist Rate A/D Converters. 4. To Understand the concepts of Nyquist Rate A/D Converters, and applications. 5. To study and to analyze the Oversampling Converters. 6.To Understand the of Continuous-Time Filters, CMOS Trans-conductors Using Triode, Active Transistors and MOSFET-C Filters.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate in-depth knowledge in Switched Capacitor Circuits.(BL2)							
CO 2	Apply the basic principles of PLL for different types of applications.(BL3)							
CO 3	Illustrate the fundamentals of Data converter.(BL2)							
CO 4	Demonstrate Nyquist Rate A/D Converters.(BL2)							
CO 5	Develop high speed modulators, interpolating & decimating filters for analog and digital communications. (BL3)							

CO-PO Mapping															
CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-						2	1			1		
CO2	3	2	1						2	1			2		
CO3	3	2	1						2	1		1	2		
CO4	3	2	1						2	1		1	2		
CO5	3	2	1						2	1		1	2		

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-1	Switched Capacitor Circuits	10hours
Introduction to Switched Capacitor circuits-basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrator first order filters, Switch sharing, bi-quad filters.		
At the end of the Module 1, students will be able to:		
1. Demonstrate first order filter with least interference.(BL2) 2. Illustrate the non-ideal characteristics of a switched capacitor integrator. (BL2) 3. Explain the two switched capacitor bi-quad realizations .(BL2)		

MODULE-2	Phased Lock Loop (PLL)	9hours
Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs-PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.		
At the end of the Module 2, students will be able to:		
1. Explain the block diagram of Phase Locked Loop (BL2).		
2. Demonstrate the basic charge pump PLL and non-ideal effects in PLLs.(BL2).		
3. Explain the Jitter in PLLs and delay locked loops.(BL2).		
MODULE-3	Data Converter Fundamentals	10hours
DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters.		
At the end of the Module 3, students will be able to:		
1. Illustrate the block diagram of a D-A converter in signal processing applications. (BL2)		
2.Explain deterministic approach and statistic approach of quantization noise in data converters.(BL2)		
3.Demonstrate a thermometer code charge redistribution D/A converter. (BL2)		
MODULE-4	Nyquist Rate A/D Converters	9hours
Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time-interleaved converters.		
At the end of the Module 4, students will be able to:		
1. Illustrate Successive-Approximation type ADC (BL2)		
2. Explain the function of a 3 bit flash ADC. (BL2)		
3. Demonstrate the operation of a multiple-bit pipeline ADC. (BL2)		
MODULE-5	Oversampling Converters	10 hours
Oversampling without noise shaping, oversampling with noise shaping, Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi-bit quantizers, Delta sigma D/A.		
At the end of the Module 5, students will be able to:		
1.Demonstrate noise shaping modulators.(BL2)		
2.Explain oversampled data converters with noise shaping(BL2)		
3. Design and analyze delta sigma D/A converter.(BL3).		
4.Explain the block diagram of second order Delta-Sigma modulator(BL2)		
Total hours:		48hours

Content beyond syllabus:

floor planning and physical design of mixed signal IC design.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Switched Capacitor Filters	https://www.youtube.com/watch?v=VVxX-AVhf4&list=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij&index=8 (Introduction to switched capacitor filters) https://www.youtube.com/watch?v=zVXzcUjOBjM&lis

		t=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij&index=10 (Design of switched capacitor Filter) https://www.youtube.com/watch?v=yFGkuCLeuvY&list=PLG4LDxYH2oQr2oxi3f_3TrGPNtoTm7ck6&index=33 https://www.youtube.com/watch?v=7g5PbXLinN0&list=PLG4LDxYH2oQr2oxi3f_3TrGPNtoTm7ck6&index=31 (Switched capacitor integrator first order filters)
2	Phase Locked Loop (PLL)	https://www.youtube.com/watch?v=7xVSL93ZZq8&list=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij&index=15 (Introduction to PLL) https://www.youtube.com/watch?v=6-BTvkd2sJA&list=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij&index=16
3	Data Converter Fundamentals	https://www.youtube.com/watch?v=G179hTsuZPU&list=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij&index=12
4	Nyquist Rate A/D Converters	https://www.youtube.com/watch?v=YGrQtUclmMc https://www.youtube.com/watch?v=waCIFx32dZE (Pipelined and Successive Approximation ADCs)
5	Oversampling Converters	https://www.youtube.com/watch?v=c35i4D19wXw (Over sampling and Noise shaping) https://www.youtube.com/watch?v=SFAS8nE4_ZM Delta sigma A/D converter https://www.youtube.com/watch?v=rqO6IVAj_NE Decimating filters and interpolating filters

Text Books:

1. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition, 2002.
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2013

Reference Books:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters- Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience,2009

Online Resources:

1. <https://www.youtube.com/playlist?list=PLLDC70psjqv5vtrb0EdII4xIKA15ec-Ij>
2. <http://www.satishkashyap.com/2012/08/video-lectures-on-mixed-signal.html>
3. <https://www.youtube.com/playlist?list=PLIkNGbJnO1kjULus09cYUhk2Y5HX2H3jA>

Web References:

1. <https://my.ece.utah.edu/~kstevens/3991/mixed-signal-design.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4011	REAL TIME OPERATING SYSTEMS							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on Embedded systems and operating systems.								
Course Objectives:								
<ol style="list-style-type: none"> To understand the basic real time concepts & reference model of real time systems. To compare various scheduling techniques in real time operating systems. To acquire knowledge on various synchronization mechanisms. To illustrate various programming tools for real time operating systems. To apply various protocols for communication in real time operating systems. To apply programming tools to study real time operating systems. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Understand the the basic real time concepts & reference model of real time systems.(BL-2)							
CO 2	Compare various scheduling techniques in real time operating systems. (BL-4)							
CO 3	Analyse various synchroniztion mechanisms for real time systems. (BL-4)							
CO 4	Illustrate various programming tools for real time operating ystems.(BL-2)							
CO 5	Apply various protocols for communication in real time operating systems.(BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	1							1	1		
CO2	1		1											2
CO3	2	2		1	2						1			1
CO4	2	1	2	2	2							2	1	
CO5		1												
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE -1	INTRODUCTION	9 hrs
Introduction - Basics of task scheduling - Cyclic executives - Cyclic scheduler - Cyclic scheduler		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Understand the basic real time concepts of real time operating systems. (BL-2) Understand various scheduling techniques in real time operating systems. (BL-2) Compare different scheduling techniques in real time systems. (BL-2) 		
MODULE -2	Characteristics of real time systems	9 hrs
Exercises on frame size selection - Event-driven schedulers - Rate monotonic algorithm - RMA task schedulability - Rate monotonic analysis.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Understand various scheduling techniques in real time operating systems. (BL-2) Analyze monolithic algorithms(BL-4) Compare various schedulability techniques in real time operating systems. (BL-4) 		

MODULE-3	MODELING TIME CONSTRAINTS	10 hrs
RMA generalizations - Further RMA generalizations - Resource sharing among real-time tasks - Solution to priority inversion problem - Highest locker protocol		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the concept of RMA in real time systems. (BL-2) 2. Understand the concept of resource sharing with examples.(BL-2) 3. Analyze various protocol mechanisms for real time systems. (BL-4) 		
MODULE-4	BASIC CONCEPTS REAL TIME OPERATING SYSTEMS	10hrs
Priority ceiling protocol - PCP priority inversions - Analysis of PCP priority inversions - Some basic issues in real-time operating systems - Unix as a real-time operating system.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate various concepts operating system services. (BL-2) 2. Acquire knowledge on protocols in RTOS Environment.(BL-2) 3. understand the issues in operating systems. (BL-1) 		
MODULE-5	REAL TIME COMMUNICATION	10hrs
CASE STUDIES: Case study Linux POSIX system, RT-Linux / RTAI, Windows system, Vx-works, uitrion Kernel design issues: structure, Process states, Data structures, Inter-task communication mechanism.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Acquire the practical knowledge in real time operating systems. (BL-2) 2. Understand the LINUX operating system multicomputer system.(BL-2) 3. Apply various inter task mechanisms in real time operating systems. (BL-3) 		
Total hours:		48 hours

Term work:

Case Study of programming with RTOS- Automatic Chocolate Vending m/c using μ COS RTOS,
Case Study of programming with RTOS- Sending application Layer byte Streams on a TCP/IP network,
Case Study of programming with RTOS- An Embedded System for a smart card.

Content beyond syllabus:

1. Embedded System design with Free RTOS
2. Embedded Firmware Design Approaches

Self-Study:

Contents to promote self-Learning:

SN	Topic	Reference
1	Hard Vs Soft Real-Time Systems	https://www.geeksforgeeks.org/difference-between-hard-real-time-and-soft-real-time-system/
2	Scheduling	https://www.freertos.org/implementation/a00005.html https://rts.eit.uni-kl.de/fileadmin/publication_files/Fohler_RTSOPS2011.pdf
3	Deadlock & priority inversion	https://code-time.com/pdf/Priority%20Inversion%20and%20Deadlock.pdf

4	Micro C/OS-II	https://www.micrium.com/rtos/kernels/
5	Resource Reservation Protocol	https://www.geeksforgeeks.org/resource-reservation-protocol-in-real-time-systems/
6	Vx Works	https://www.operating-system.org/betriebssystem/_english/bs-vxworks.htm

Text Book(s):

1. J. J. Labrosse, "MicroC/OS-II: The Real –Time Kernel", Newnes, 2002.
2. Jane W. S. Liu, "Real-time systems", Prentice Hall, 2000

Reference Book(s):

1. W. Richard Stevens, "Advanced Programming in the UNIX® Environment", 2nd edition, Pearson Education India, 2011.
2. Philips A. Laplante, "Real-Time System Design and Analysis", 3rd edition, John Wley & Sons, 2004.
3. Doug Abbott, "Linux for Embedded and Real-Time Applications", Newnes, 2nd edition, 2011.

Online Resources:

1. <https://nptel.ac.in/courses/106/105/106105086/>
2. https://swayam.gov.in/nd1_noc20_cs16/
3. <https://www.youtube.com/watch?v=1fwxHAf1E88>

Web References:

1. [http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000007CS/P001072/M022511/ET/1504846042lect24-RTOs-modified\(1.pdf](http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000007CS/P001072/M022511/ET/1504846042lect24-RTOs-modified(1.pdf)
2. <https://www.guru99.com/real-time-operating-system.html>
3. <http://beru.univ-brest.fr/~singhoff/cheddar/publications/audsley95.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4012	ELECTRONIC MEASUREMENTS & INSTRUMENTATION							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CI E	SEE	TOTAL
VI	3	0	0	48	3	40	60	100
Pre-requisite: Engineering physics, Basic Principles of Electrical Engineering (Circuit Theory), Basic Digital and Analog Electronics								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand the measuring methods and instruments of electrical quantities. 2. To understand, design aspects and performance criterion of measuring instruments. 3. To understand the working principle of various transducers. 4. To aware the students about the different types of bridges 5. To understand about transducers. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the characteristics and operation of different instruments.(BL:2)							
CO2	Examine the operation of CRO.(BL:4)							
CO 3	Apply the knowledge of signal generators to test the circuits.(BL:3) Explain the operation of signal Analysers. (BL:2)							
CO 4	Construct AC and DC bridges.(BL:3)							
CO 5	Explain transducers operation. (BL:2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2		2									1	2	
CO2	2	1											1	
CO3	2	1											1	
CO4	2	1	2										1	
CO5	2	2	2										2	
CO6	2	1	2									2	2	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-1	Performance characteristics of instruments:	9h
<p>Performance characteristics of instruments: Static characteristics, accuracy, resolution, precision, expected value, error and sensitivity. Errors in measurement and dynamic characteristics: speed of response, fidelity, lag and dynamic error.(6h)</p> <p>Voltmeters: Multirange, range extension, solid state and differential voltmeters.</p> <p>Ammeters: Shunt and thermocouple type ammeter.</p> <p>Ohmmeters: Series type, shunt type, multimeter for voltage, current and resistance measurements.</p> <p>Digital multimeters: Block diagram and specifications.(3h)</p> <p>At the end of the Module 1, students will be able to:</p> <ul style="list-style-type: none"> ▪ Explain the characteristics of instrument.(BL:2) ▪ Illustrate the use of different measuring instruments.(BL:2) ▪ Demonstrate working principles of voltmeters, ammeters, ohmmeters and multimeters. (BL:2) 		
MODULE-2	Cathode Ray Oscilloscopes	10h

Cathode Ray Oscilloscopes: CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, dual beam CRO, measurement of amplitude and frequency. Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital storage oscilloscope, Lissajous method of frequency measurement, standard specifications of CRO, probes for CRO (active and passive), attenuator type (10h)

At the end of the Module 2, students will be able to:

- Explain the operation of CRO. (BL:2)
- Demonstrate various measurements made with CRO. (BL:2)

Compare different CRO's. (BL:2)

At the end of the Module 4, students will be able to:

- Explain the operation of CRO. (BL:2)
- Demonstrate various measurements made with CRO. (BL:2)

Compare different CRO's. (BL:2)

MODULE-3	Signal Generators & Signal Analyzers	10h
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Signal Generators: Fixed and variable, AF oscillators, standard and AF sine and square wave signal generators, function Generators, square pulse, random noise and sweep. (5h)

Signal Analyzers: AF, HF Wave Analyzers. Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, digital Fourier analyzers, Capacitance-Voltage Meters, Oscillators.(5h)

At the end of the Module 3, students will be able to:

- Explain the importance of signal generators.(BL:2)
- Explain different types of signal generators. (BL:2)

Compare various signal generators. (BL:2)

- Explain the operation of signal analyzers. (BL:2)
- Illustrate the use of analyzers in industrial applications. (BL:2)
- Compare various analysers. (BL:2)

MODULE-4	Bridges	10h
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AC Bridges: Measurement of inductance: Maxwell's bridge, Anderson bridge.Measurement of capacitance: Schearing bridge. Kelvin's bridge, Wheatstone bridge and Wien Bridge. Errors and precautions and related problems. Q – Meter.(6h)

DC Bridges: Wheat Stone Bridge, Kelvin Bridge and Megaohm Bridge(4h)

At the end of the Module 4, students will be able to:

- Explain AC and DC bridge circuits. (BL:2)
- Construct Bridge circuits. (BL:2)

Define the errors and compensation techniques in bridge circuits. (BL:2)

MODULE-5	Active and passive transducers	9h
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Active and passive transducers: Resistance, capacitance, inductance, strain gauges, LVDT, piezo electric transducers, resistance thermometers, thermocouples, thermistors and sensistors. Basic Hall Effect sensors. Calibration and standards and data acquisition systems.(9h)

At the end of the Module 5, students will be able to:

- Define calibration, active and passive transducers. (BL:2)
- Explain working of transducers and data acquisition systems.(BL:2)
- Summarize the applications of sensors and transducers. (BL:2)

Total hours:	48 hours
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Term work:
 Calibrate a transducers, tabulate the readings and plot the characteristics .
 (i)LVDT (ii) RTD (iii)Strain Gauge

Self Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	characteristics of instruments	https://nptel.ac.in/courses/112/107/112107242/
2	CRO	https://nptel.ac.in/courses/108/105/108105153/
3	Signal Generators & Wave Analysers	https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_signal_generators.htm https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_wave_analyzers.htm
4	Bridges	https://nptel.ac.in/courses/108/105/108105153/
5	Transducers	https://nptel.ac.in/courses/112/107/112107242/

Text Book(s):

1. Electronic instrumentation – H.S.Kalsi, Tata McGraw Hill, 2004, 2/e.
2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 2002, 5/e.
3. A Course In Electrical And Electronics Measurements And Instrumentation, Shawhney A. K

Reference Book(s):

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2003, 2/e.
2. Electronic Test Instruments, Analog and Digital Measurements – Robert A.Witte, Pearson Education, 2004, 2/e.
3. Instrumentation Devices And Systems, Rangan C. S., Sarma G. R. and Mani V. S. V.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105153/#>
2. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
3. <https://nptel.ac.in/courses/112/107/112107242/>

Web References:

1. <https://civildatas.com/download/a-course-in-electronic-measurements-and-instrumentation-by-a-k-sawhney>
2. <https://civildatas.com/download/electronic-instrumentation-by-kalsi>
3. <https://www.proinso.net> > ... > 6 > transducers-lecture-notes-nptel.pdf · PDF file
4. <https://instrumentationtools.com> > tag > sensors-and-transducers-nptel-pdf
5. <https://onlinecourses.nptel.ac.in> > noc21_ee32 > preview

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4013	SATELLITE COMMUNICATIONS							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Knowledge of fundamentals of Engineering Physics and chemistry								
Course Objectives:								
<ol style="list-style-type: none"> To understand functional principles and orbital mechanics of satellite communication system. To summarize the various hardware systems associated with a satellite and the ground station. To design appropriate uplinks and down links for satellites. To Select an appropriate modulation and multiple access schemes for a given satellite communication link. To Analyze communication satellites and the national satellite system To illustrate the services provided by the satellite and its future applications 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret functional principles and orbital mechanics of satellite communication system.(BL:2)							
CO 2	Design appropriate uplinks and down links for satellites (BL:3)							
CO 3	Choose an appropriate modulation and multiple access schemes for a given satellite communication link(BL:3)							
CO 4	Analyze communication satellites and the national satellite system (BL:3)							
CO 5	Illustrate the services provided by the satellite and its future applications(BL:2)							

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										2	3
CO2	3	2	3										2	3
CO3	3	2	2										2	3
CO4	3	1	2										2	3
CO5	3	1	2										2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE -1	INTRODUCTION & ORBITAL MECHANICS	10Hrs
<p>Introduction: Origin of satellite communications, Historical background, basic concepts of satellite communications, frequency allocations for satellite services, applications, future trends of satellite communications.</p> <p>Orbital Mechanics: Look angle determination, orbital perturbations, orbit determination, launches and launch vehicles, orbital effects in communication systems performance.</p> <p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> Explain the basic principles and operation of satellite communication system(BL-2) Outline the various applications of satellite systems. (BL-2) Summarize various types of satellites. (BL-2) Outline the orbits and trajectories of satellite with associated parameters. (BL-2) 		
MODULE -2	SATELLITE SUBSYSTEMS AND LINK DESIGN	10Hrs

Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.

Basic transmission theory, system noise temperature and G/T ratio, design of down links, uplink design, design of satellite links for specified C/N, system design example.

At the end of the Module 2, students will be able to:

1. Describe various hardware subsystems involved in satellite communication and its functionalities. (BL-2)
2. Outline the various types of earth stations and their design parameters. (BL-2)
3. Explain design of satellite links (BL-2)

MODULE-3	MULTIPLE ACCESS	08 Hrs
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Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

At the end of the Module 3, students will be able to:

1. Explain Multiple access schemes
2. Describe Various modulation schemes used in satellite communication

MODULE-4	COMMUNICATION SATELLITES	10Hrs
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Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems.

At the end of the Module 4, students will be able to:

1. Describe various frequency bands of communication satellites. (BL-2)
2. Compare satellite and terrestrial networks. (BL-2)
3. Outline the concepts of regional and national satellite systems. (BL-2)

MODULE-5	SATELLITE APPLICATIONS	10Hrs
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INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS) - Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- World space services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.

At the end of the Module 5, students will be able to:

1. Explain applications of Geo-Stationary satellites. (BL-2)
2. Outline the various mobile satellite services(BL-2)
3. Explain the various applications of direct broadcast satellites(BL-2)
4. Outline the specialized services provided by satellite. (BL-2)

	Total hours:	48 Hrs
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Term work:

1. List out live **Indian satellites** as on Today. Submit the report on each satellite with following details:
 1. Location of satellite (orbit)
 2. Date of launching
 3. Life period
 3. Applications
2. List out live **Americian satellites** as on Today. Submit the report on each satellite with following details:
 1. Location of satellite (orbit)
 2. Date of launching
 3. Life period
 3. Applications
3. List out live **china satellites** as on Today. Submit the report on each satellite with following details:
 1. Location of satellite (orbit)
 2. Date of launching
 3. Life period
 3. Applications
4. List out live **Russian satellite** as on Today.. Submit the report on each satellite with following details:
 1. Location of satellite (orbit)
 2. Date of launching
 3. Life period
 3. Applications

Content beyond syllabus:	Geostationar
1.	y, Remote sensing and weather forecasting satellites

Self-Study:

Contents to promote self-Learning:

SN O	Topic	Reference
1	Principles of satellite Communication	https://www.tutorialspoint.com/principles_of_communication/principles_of_satellite_communications.htm
2	Earth station	https://www.sciencedirect.com/topics/engineering/earth-station
3	Satellite uplink and downlink design	http://www.brainkart.com/article/Satellite-uplink-and-downlink-Analysis-and-Design_11927/
4	CDMA	https://www.electronics-notes.com/articles/radio/dsss/cdma-what-is-code-division-multiple-access-tutorial.php
5	Satellite Television	https://electronics.howstuffworks.com/satellite-tv4.htm
6	Applications of satellites	https://www.javatpoint.com/applications-of-satellite-systems

Text Book(s):

1. T. Pratt and S. W. Bostian, Satellite Communication John Wiley and Sons.
2. S. K. Raman, Fundamentals of Satellite Communication, 1st edition, Pearson, 2011
3. Wilbur L. Prichard, Robert A. Nelson & Henry G. Snyderhoud, "Satellite communications Engineering", Pearson Publications, 2nd Edition, 2003.
4. Dennis Roddy, Satellite Communications:, Tata McGrawHill, fourth edition.

Reference Book(s):

5. D.C. Agarwal, "Satellite communications", Khanna publications, 5th Ed.
6. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.
7. Tri. T. Ha, "Digital satellite communication system", McGraw Hill.

Online Resources:

1. http://www.brainkart.com/subject/Satellite-Communication_189/
2. https://content.kopykitab.com/ebooks/2018/04/17804/sample/sample_17804.pdf
3. [https://pcefet.com/common/library/books/31/711 \[Louis J. Ippolito Jr.\] Satellite Communications S\(b-ok.org\).pdf](https://pcefet.com/common/library/books/31/711_[Louis_J._Ippolito_Jr.]_Satellite_Communications_S(b-ok.org).pdf)

Web References:

1. <https://nptel.ac.in/courses/117/105/117105131/>
2. https://www.youtube.com/watch?v=H00_PVX2bRw

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4014	Introduction to MEMS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Knowledge of fundamentals of Engineering Physics and chemistry								
Course Objectives:								
<ol style="list-style-type: none"> To give an exposure about the basics of MEMS To understand the materials involved in MEMS To Know about fabrication process of micro machined or micro structure devices To describe MEMS sensor and Accelerometers To Know applications of RF MEMS devices 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Illustrate the basics of MEMS (BL-2)							
CO 2	Understand the Micro fabrication technology of MEMS (BL-2)							
CO 3	Interpret the concept of micro electronic technology for MEMS micro sensors(BL-2)							
CO 4	Analyze the processing techniques for MEMS accelerometers (BL-4)							
CO 5	Demonstrate the applications of MEMS in various fields (BL-2)							

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3										2		
CO2	3	3			1							1	3	1
CO3	3	2	2		1							3		3
CO4	3	1	2		2							1		3
CO5	3	3	3		1							3	3	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE -1	INTRODUCTION TO MEMS	9hrs
Introduction to MEMS & Microsystems, Introduction to micro sensors, Evaluation of MEMS, Microsensors, Market Survey, Application of MEMS, MEMS materials, MEMS materials properties.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain Basic concepts of MEMS(BL-2) Outline MaterialsInvolved in MEMS(BL-2) List Applications of MEMS(BL-1) 		
MODULE -2	MICROELECTRONIC TECHNOLOGY FOR MEMS	10hrs

Microelectronic Technology for MEMS, Micromachining Technology for MEMS, Micromachining Process, Etch Stop Techniques and Microstructure, Surface and Quartz Micromachining, Fabrication of Micro machined Microstructure, Micro-stereo lithography.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Describe Fabrications Process of Microelectronics for MEMS (BL-2) 2. Explain surface and quartz micromachining(BL-2) 3. Describe Micro-stereo lithography(BL-2) 		
MODULE-3	MICRO SENSORS	9hrs
MEMS Micro-sensors, Thermal Micro-sensors, Mechanical Micro machined Micro-sensors, MEMS Pressure Sensor, MEMS Flow Sensor, Micro-machined Flow Sensors, MEMS Inertial Sensors, MEMS Gyro Sensor.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain concept of Micro sensors (BL-2) 2. Describe working principle MEMS Thermal sensors(BL-2) 3. Describe working principle MEMS Pressure (BL-2) 4. Describe working principle MEMS Flow sensor(BL-2) 5. Illustrate principle of MEMS Inertial Sensors(BL-2) 		
MODULE-4	MEMS ACCELEROMETERS	10hrs
Micro-machined Micro accelerometers for MEMS, MEMS Accelerometers for Avionics, Temperature Drift and Damping Analysis, Piezo resistive Accelerometer Technology, MEMS Capacitive Accelerometer, MEMS Capacitive Accelerometer Process, MEMS for Space Application.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Explain concept of MEMS Accelerometers(BL-2) 2. Design Piezoresistive MEMS Accelerometers(BL-2) 3. Design Capacitive MEMS Accelerometers(BL-2) 4. Explain function of MEMS for space application(BL-2) 		
MODULE-5	MEMS APPLICATIONS	10hrs
Polymer MEMS & Carbon Nano Tubes CNT, Wafer Bonding & Packaging of MEMS, Interface Electronics for MEMS, Introduction to Bio-MEMS and Micro Fluidics, Introduction to Bio Nano-Technology, Bio Sensors, Fluidics, MEMS for Biomedical Applications (Bio-MEMS).		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the interface electronics MEMS(BL-2) 2. Describe Bio Sensors (BL-2) 3. Explain MEMS for Biomedical applications (BL-2) 		
		Total hours: 48 hrs

Term work:

Develop simulation model of MEMS Accelerometer for aerospace application with dynamic range 40dB, Resolution 10 mg and power dissipation below 10mW using MTLAB Simulink

Content beyond syllabus:

Computer- aided design for MEMS, NEMS (3h)

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	Introduction to MEMS	https://www.allaboutcircuits.com/technical-articles/introduction-to-mems-microelectromechanical-systems/ http://home.eps.hw.ac.uk/~ryf1/MEMS%20Introduction.htm https://www.youtube.com/watch?v=CNmk-SeMOZI
2	Microelectronic Technology for MEMS	https://electronics360.globalspec.com/article/8638/detailing-g-mems-fabrication-techniques
3	MEMS Sensors	https://www.elprocus.com/mems-sensor-working-and-its-applications/ https://www.electronicsforu.com/resources/learn-electronics/mems-sensors-available-market https://www.youtube.com/watch?v=HJb-6y1O8sl
4	MEMS Accelerometers	https://www.youtube.com/watch?v=T_iXLNkkjFo https://www.pcb.com/resources/technical-information/mems-accelerometers
5	MEMS Applications	https://www.youtube.com/watch?v=71bvpRZkcwE https://www.youtube.com/watch?v=FJC091BJzBc

Text Book(s):

1. Nadim Maluf Kirt Williams “An Introduction to Micro electromechanical Systems Engineering”, Second Edition, Artech House, Inc. Boston London.
2. T. M. Adams, Introductory to MEMS, Springer, 2010.

Reference Book(s):

1. Varadan, V Kand Varadan “Micro-sensors, actuators, MEMS, and electronics for smart structures” Rai-Choudhury P (ed.) Handbook of Microlithography, Micromachining, and Micro fabrication, SPIE Optical Engineering Press
2. J. Allen, Micro Electro Mechanical system design, CRC Press 2009.

Online Resources

1. <https://nptel.ac.in/courses/117/105/117105082/>
2. <https://ece.northeastern.edu/edsnu/mcgruer/class/MEMS/>

Web References:

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/lecture-notes/>
2. <https://mescyclopedia.org/introMEMS.html>

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4015	INTRODUCTION TO MACHINE LEARNING							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Signals and Systems								
Course Objectives:								
1.To understand statistical decision theory								
2. To understand shrinkage methods								
3. To explain perceptron learning								
4. To evaluate instability measures								
5. To explain bootstrapping and cross validation								
6. To learn various graphical methods								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Recall probability theory (BL-1)							
CO 2	Explain regression methods (BL-2)							
CO 3	Understand early model (BL-2)							
CO 4	Explain decision and regression trees (BL-2)							
CO 5	Describe gradient boosting (BL-1)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	3											1	
CO2	3	3												
CO3	3	3	2										1	
CO4	3	3	3											
CO5	3	3	3										1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION	9Hrs
Probability Theory, Linear Algebra, Convex Optimization - (Recap) Week 1: Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance.		
At the end of the Module 1, students will be able to:		
1. Understand probability theory (BL-2)		
2. Explain linear algebra (BL-2)		
3. Describe statistical decision theory (BL-1)		
MODULE -2	REGRESSION AND CLASSIFICATION	9 Hrs
Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods, Principal Component Regression, Partial Least squares.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Explain linear regression (BL-2) 2. Understand shrinkage methods (BL-2) 3. Calculate partial least squares (BL-4) 		
MODULE-3	SVM AND NEURAL NETWORKS	9 Hrs
Linear Classification, Logistic Regression, Linear Discriminant Analysis, Perceptron, Support Vector Machines. Neural Networks - Introduction, Early Models, Perceptron Learning, Back propagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Recall logistic regression (BL-1) 2. Understand Linear discriminant analysis (BL-2) 3. Explain perceptron learning (BL-2) 		
MODULE-4	DECISION TREE AND REGRESSION TREES	12Hrs
Decision Trees, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multi-way Splits, Missing Values, Decision Trees - Instability Evaluation Measures, Bootstrapping & Cross Validation, Class Evaluation Measures, ROC curve, MDL, Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Understand decision and regression trees (BL-2) 2. Evaluate instability measures (BL-5) 3. Understand bootstrapping and cross validation (BL-2) 		
MODULE-5	BAYESIAN NETWORKS	9 Hrs
Gradient Boosting, Random Forests, Multi-class Classification, Naive Bayes, Bayesian Networks, In-directed Graphical Models, HMM, Variable Elimination, Belief Propagation, Partitional Clustering.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Describe gradient boosting (BL-1) 2. Understand Naive bayes (BL-2) 3. Explain partial clustering (BL-2) 		
		Total hours: 48 hours

Term work:			
1.			
Content beyond syllabus:			
1. Introduction to genetic and heuristic algorithms			
Self-Study:			
Contents to promote self-Learning:			
SNO	Topic	CO	Reference

1	Statistical decision theory	CO1	https://towardsdatascience.com/statistical-decision-theory-382b04f517f2
2	Linear regression	CO2	https://www.javatpoint.com/linear-regression-in-machine-learning
3	Neural networks	CO3	https://www.ibm.com/in-en/cloud/learn/neural-networks
4	Decision tree and regression tree	CO4	https://medium.com/analytics-vidhya/regression-trees-decision-tree-for-regression-machine-learning-e4d7525d8047
5	Bayesian networks	CO5	https://www.uib.no/en/rg/ml/119695/bayesian-networks#:~:text=A%20Bayesian%20network%20is%20a,ne%20work%20is%20learned%20from%20data.

Text Book(s):

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.

Reference Book(s):

1. O. Theobald, Machine Learning for absolute beginners, second edition, 2016
2. A. C. Muller & S Guido, Introduction to Machine Learning, OReilly, 2015.

Online Resources:

1. <https://www.youtube.com/watch?v=q8i-WKtkQ6I>
2. <https://www.youtube.com/watch?v=E5RjzSK0fvY>
3. <https://www.youtube.com/watch?v=bfmFfD2RIcg>
4. <https://www.youtube.com/watch?v=RmajweUfKvM>

Web References:

1. <https://www.goseeko.com/reader/notes/aryabhata-knowledge-university-bihar/engineering/computer-engineering-1/third-year/sem-2/machine-learning-11/unit-2-statistical-decision-theory-4>
2. <https://www.analyticsvidhya.com/blog/2021/06/linear-regression-in-machine-learning/>
3. <https://wiki.pathmind.com/neural-network>

NARAYANA ENGINEERING COLLEGE:GUDUR																				
20EC4016	RF INTEGRATED CIRCUITS							R2020												
Semester	Hours / Week			Total hrs	Credit	Max Marks														
	L	T	P			C	CIE	SEE	TOTAL											
VII	3	0	0	48	3	40	60	100												
Pre-requisite: Analog Electronics																				
<table border="1"> <thead> <tr> <th>Module 1</th> <th>Module 2</th> <th>Module 3</th> <th>Module 4</th> <th>Module 5</th> <th>Total hours</th> </tr> </thead> <tbody> <tr> <td>08</td> <td>10</td> <td>10</td> <td>10</td> <td>10</td> <td>48</td> </tr> </tbody> </table>									Module 1	Module 2	Module 3	Module 4	Module 5	Total hours	08	10	10	10	10	48
Module 1	Module 2	Module 3	Module 4	Module 5	Total hours															
08	10	10	10	10	48															
Course Objectives:																				
<ol style="list-style-type: none"> To analyze RF and wireless communication integrated circuits To understand concept of Integrated Passive components To understand MOS physics. To know design of High frequency amplifier To design low noise Amplifier, RF Power amplifier, and RF Mixer 																				
Course Outcomes: After successful completion of the course, the student will be able to:																				
CO 1	Explain the architecture of RF system. (BL-02)																			
CO 2	Analyze MOS FET physics and distributed systems. (BL-02)																			
CO 3	Design high frequency amplifier for RF applications. (BL-03)																			
CO 4	Analyze various mixers for RF integrated Circuits. (BL-03)																			
CO 5	Analyze PLL and power amplifiers for RF applications. (BL-03)																			

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		1	1								1	2	
CO2	3		2	1	2							1	2	
CO3	3	2	2	2								2	2	
CO4	2		1	2								2	1	
CO5	3	2	2	1	2	1						2	2	
1: Low, 2-Medium, 3- High														
COURSE CONTENT														
MODULE -1	INTRODUCTION RF SYSTEMS												08 Hrs	
Introduction to RF and wireless systems, basic concepts of RF design, Transmission media and reflections, Maximum power transfer, Parallel RLC Tank, Series RLC Networks, RLC Networks as impedance Transformers, Interconnect at radio frequencies: Skin effect, resistors, Capacitors, Inductors, Transformers (08 Hrs)														
At the end of the Module 1, students will be able to:														
<ol style="list-style-type: none"> Understand the basic concepts of RF design. (BL-02) Explain the concept of series and parallel RLC networks. (BL-02) Explain how maximum power transfer can be obtained (BL-02) 														
MODULE -2	A REVIEW OF MOS DEVICE PHYSICS												10 Hrs	
Introduction to MOSFET physics, The long – channels approximation, operation in weak inversion (sub threshold), MOS device physics in the short – channel regime, Other effects. Link between lumped and distributed regimes driving-point impedance of iterated structures, Transmission lines in more detail,														

Behavior of Finite – length transmission lines, summary of transmission line equations (10 Hrs)		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concepts of MOS physics. (BL-02) 2. Explain the Link between lumped and distributed systems. (BL-02) 3. Summarize transmission line theory. (BL-02) 		
MODULE-3	HIGH FREQUENCY AMPLIFIER DESIGN	(10 Hrs)
Introduction, The smith chart, S-parameters, Band Width Estimation Techniques, Introduction, The method of open – circuit time constant, The method of short circuit time constant, Risetime, Delay and bandwidth. Zeros as bandwidth Enhancers, The shunt –series amplifier, Bandwidth Enhancement with FT Doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM – PM conversion. (10 Hrs)		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Design high frequency amplifier for RF applications. (BL-03) 2. Explain the concept of Bandwidth Enhancement with FT Doublers. (BL-02) 3. Summarize various Band Width Estimation Techniques. (BL-02) 		
MODULE-4	LOW NOISE AMPLIFIER DESIGN	(10 Hrs)
Introduction, Derivation of intrinsic MOSFET two-port noise parameters, LNA topologies: Power match versus noise match, Power-constrained noise optimization, Design examples, linearity and large signal performance, Spurious – free Dynamic range. Mixers: Introduction, Mixer fundamental, Nonlinear systems as linear mixers. (10 Hrs)		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Design low noise amplifier for RF integrated Circuits. (BL-03) 2. Compare various LNA topologies. (BL-02) 3. Understand the basic concepts of mixers. (BL-02) 		
MODULE- 5	RF POWER AMPLIFIERS AND FREQUENCY SYNTHESIS	10 Hrs
Introduction, general considerations, Class A, AB, B and C power amplifier, Class D amplifiers, Class E amplifiers Class F amplifiers, summary of PA characteristics, RF PA design examples. Voltage controlled oscillators, Resonators, Negative resistance oscillators, Phase locked loops, Linearized PLL models, Phase detectors, charge pumps, Loop filters, and PLL design examples. Frequency synthesis and oscillators, Frequency division, integer-N synthesis, Fractional frequency, synthesis, Phase noise, Circuit examples. (10 Hrs)		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Summarize various RF power amplifiers. (BL-02) 2. Understand the concept of power amplifiers. (BL-02) 3. Explain the concept of negative resistance and voltage controlled oscillators. (BL-02) 4. List the applications of PLL. (BL-01) 		

Term work:		
Design an RF receiver for a ZigBee application using a top-down methodology having following specification		
<ol style="list-style-type: none"> 1. Data rate = 250 kbps 2. Sensitivity specification = -100 dBm 3. Bit Error Rate (BER) specification = 1e-4 		
Content beyond syllabus:		
1.	Integrated circuit by CAD tools	Layout of RF
Self-Study:		
Contents to promote self-Learning:		
SNO	Topic	Reference

1	Passive RF components	https://www.allaboutcircuits.com/textbook/radio-frequency-analysis-design/rf-principles-components/passive-components-in-rf-circuits/ https://www.youtube.com/watch?v=3iXLuvbPSSY
2	MOSFET fundamentals	https://www.elprocus.com/mosfet-as-a-switch-circuit-diagram-free-circuits/ https://www.youtube.com/watch?v=p34w6ISouZY https://www.youtube.com/watch?v=MubiC9yz2fc
3	High Frequency Amplifier design	https://www.tutorialspoint.com/amplifiers/tuned_amplifiers.htm (Tuned amplifiers) https://www.elprocus.com/cascade-amplifier-working-applications/ (Cascaded amplifiers) https://www.youtube.com/watch?v=kVPzU7Eszk4
4	LNA and Mixers	https://web.ece.ucsb.edu/~long/ece145a/LNAdesign.pdf https://www.youtube.com/watch?v=2t_FQDnBIGM&list=PLR108hHgAgaoS0MBwcYZgFQ9y51PCaih
5	RF power amplifiers and PLL	https://circuitdigest.com/tutorial/classes-of-power-amplifier-explained (Classes of Power Amplifiers) https://www.elprocus.com/voltage-controlled-oscillator-working-application/ (Voltage controlled oscillators) https://www.youtube.com/watch?v=uy4opULxcdg
6	Frequency Synthesis	https://blog.pasternack.com/uncategorized/basics-frequency-synthesizers-oscillators/ (Frequency synthesis and oscillators) https://www.youtube.com/watch?v=z-50pSc_wg8

Text Book(s):

1. Behzad Razavi, RF Microelectronics , 2nd Edition (2012) (Publisher: Pearson),
2. Thomas H. Lee ,The Design Of CMOS Radio-Frequency Integrated Circuits 2nd Edition (2006) (Publisher: Cambridge University Press),
3. Gray, Meyer, Hurst, Lewis, Wiley, Analysis and design of analog integrated circuits , Gray, Meyer, Hurst, Lewis, Wiley, c2001

Reference Book(s):

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, McGraw-Hill, 2001.
2. RF Circuit Design, Ludwig R. and Bogdanov G Prentice Hall, 2007.
3. Wolaver D H, Phase-Locked Loop Circuit Design, Prentice Hall, 1991

Online Resources:

1. www.designers-guide.org
2. <https://www.britannica.com/technology/integrated-circuit>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/lecture-notes/>
4. https://www.electronics-tutorials.ws/amplifier/amp_5.html

Web References:

1. <http://www.ee.iitm.ac.in/~ani/2013/ee6240/>
2. <http://ic.sjtu.edu.cn/ic/dic/wp-content/uploads/sites/10/2013/04/Rabaey-Digital-Integrated-Circuits-A-Design-Perspective.pdf>
3. <https://www.mobt3ath.com/uploade/book/book-53605.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4017	INTRODUCTION TO INTERNET OF THINGS							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Basic programming knowledge.								
Course Objectives:								
<ol style="list-style-type: none"> To study fundamental concepts of IoT To build simple IoT Systems by integration of sensors and actuators with Arduino. To expose the student to a variety of embedded boards and IoT Platforms To understand data analytics and cloud in the context of IoT To create simple IoT applications. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Understand the various concepts, terminologies and architecture of IoT systems.(BL-2)							
CO 2	Apply design concept to IoT solutions.. (BL-3)							
CO 3	Apply the concept of Rasperry Pi to implement an IoT/(BL-3)							
CO 4	Apply data analytics and use cloud offerings related to IoT (BL-3)							
CO 5	Create IoT solutions using sensors, actuators and Devices.(BL-6)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1		1							1	2	1
CO2	3	2	1		2							2	2	2
CO3	3	2	2	1	2							2	2	2
CO4	3	2	2	1	2							2	2	2
CO5	3	2	3		3							2	2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION	10 Hrs
Introduction to IoT, Sensing, Actuation, Basics of networking, Communication protocols, Sensor networks, Machine-to-Machine communications, Interoperability in IoT.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain IoT architecture. [BL-2] Interpret different protocols and compare them [BL-2] Utilize the Internet communication protocols for IoT applications [BL-3] 		
MODULE -2	ARDUINO PROGRAMMING	9 Hrs
Introduction to Arduino programming, Integration of sensors and actuators with arduino, Introduction to Python programming.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Outline the architecture of Arduino [BL-2] Develop simple applications using Arduino [BL-3] Explain about python programming [BL-2] 		
MODULE-3	RASPERRY PI	10 Hrs
Introduction to Rasperry Pi, Implementation of IoT with rasperry Pi, Introduction to SDN, SDN for IoT.		

At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Outline the architecture of Raspberry Pi [BL-2] 2. Develop simple applications using Raspberry Pi [BL-3] 3. Explain the concept of SDN for IoT[BL-2] 		
MODULE-4	DATA HANDLING AND ANALYTICS	9 Hrs
Data handling and analytics, Cloud computing, Sensor-Cloud, Fog computing.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the concept of Cloud computing[BL-2] 2. Use various techniques of data storage and analytics in IoT[BL-3] 		
MODULE-5	APPLICATIONS OF IOT	10 Hrs
Smart cities and smart homes, Connected vehicles, Smart grid, Industrial IoT, Agriculture, Healthcare, Activity monitoring.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Explain various applications of IoT[BL-2] 2. Design a solution for a given IoT application [BL-6] 		
		Total hours: 48 Hours

Content beyond syllabus:

1. Business Model Canavas
2. Lean Startup

Self-Study:

Contents to promote self-Learning:

SN O	Module	Reference
1	INTRODUCTION	https://archive.nptel.ac.in/courses/106/105/106105166
2	ARDUINO PROGRAMMING	https://archive.nptel.ac.in/courses/106/105/106105166
3	RASPBERRY PI	https://archive.nptel.ac.in/courses/106/105/106105166
4	DATA HANDLING AND ANALYTICS	https://archive.nptel.ac.in/courses/106/105/106105166
5	APPLICATIONS OF IOT	https://archive.nptel.ac.in/courses/106/105/106105166

Text Book(s):

1. 1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0, CRC Press.

Reference Book(s):

1. 1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons, 1st edition, 2014.
2. Matt Richardson, Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 3rd edition, 2014.
3. Arshdeep Bahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.

Online Resources/ Web referenes:

1. <https://archive.nptel.ac.in/courses/106/105/106105166>
2. <https://www.youtube.com/watch?v=7PSgFZowdr8>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4018	BIO-MEDICAL INSTRUMENTATION							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Subject (Human being) Stimulous,transducers,signal conditioning equipment,control device.								
Course Objectives:								
<ol style="list-style-type: none"> To understand fundamentals of Biomedical Instrumentation. To familiarize with the electrodes used in medical Instrumentation. To study various Bio-medical Instruments. To analyse the bio electrical signals. To understand the safety measures for medical equipment. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the components of medical instruments and fundamentals of cell.(BL-2)							
CO 2	Demonstrate the working of Bio-electrodes. (BL-2)							
CO 3	Explain the significance of cardiac Instrumentation. (BL-2)							
CO 4	Illustrate the principles of Neuro-muscular Instrumentation. (BL-2)							
CO 5	Explain respiratory Instrumentation & Summarize the safety measures of bio-medical equipment. (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												2	
CO2	2	2										1	2	
CO3	2	2										1	2	
CO4	2	2										1	2	
CO5	2	2										1	2	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
Module-1	Components of Medical Instrumentation System	10hrs
<p>Components of Medical Instrumentation System, Bio – amplifier, Static and dynamic characteristics of medical instruments, Bio signals and characteristics, Problems encountered with measurements from human beings. (5h)</p> <p>Organisation of cell, Derivation of Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential,Conduction through nerve to neuro-muscular junction. (5h)</p> <p>At the end of the Module 1, students will be able to:</p> <ul style="list-style-type: none"> Explain basic components of medical equipment.(BL-2) Explain cell structure. (BL-2) Define action,resting potentials. (BL-1) 		
Module-2	Electrodes in Medical Instrumentation	8hrs
<p>Bio Electrodes – Biopotential Electrodes-External electrodes, Internal Electrodes, Biochemical Electrodes Mechanical function, Electrical Conduction system of the heart, Cardiac cycle, Relation between electrical and mechanical activities of the heart.(8h)</p> <p>At the end of the Module 2, students will be able to:</p> <ul style="list-style-type: none"> Explain working of bio-electrodes.(BL-2) Classify types of electrodes based on measurement.(BL-2) Explain mechanical action of heart. (BL-2) 		
Module-3	Cardiac Instrumentation	10hrs

Cardiac Instrumentation Blood pressure and Blood flow measurement, Specification of ECG machine, Einthoven triangle, Standard 12-lead configurations, Interpretation of ECG waveform with respect to electromechanical activity of the heart, Therapeutic equipment, Pacemaker, Defibrillator, Shortwave diathermy, Hemodialysis machine..(10h)		
At the end of the Module 3, students will be able to: <ul style="list-style-type: none"> ▪ Explain cardiac instrumentation concepts. (BL-2) ▪ Demonstrate working of ECG. (BL-2) ▪ Interpret ECG waveforms. (BL-2) 		
Module-4	Neuro-Muscular Instrumentation	8hrs
Neuro-Muscular Instrumentation ,Specification of EEG and EMG machines, Electrode placement for EEG and EMG recording, Interpretation of EEG and EMG.(8h)		
At the end of the Module 4, students will be able to: <ul style="list-style-type: none"> ▪ Explain the basics of neuro muscular activity. (BL-2) □□ Demonstrate working of EEG. (BL-2) ▪ Interpret EEG and EMG signals. (BL-2) 		
Module-5	Respiratory Instrumentation & Safety Measures	12hrs
Respiratory Instrumentation Mechanism of respiration, Spirometry, Pneumotachograph Ventilators. (6h), Patient electrical safety, types of hazards , natural protective mechanism, leakage current, patient isolation, hazards in operation rooms, grounding conditions in hospital environment.(6h)		
At the end of the Module 5, students will be able to: <ul style="list-style-type: none"> ▪ Explain respiratory instrumentation fundamentals. (BL-2) ▪ Explain about ventilators.(BL-2) ▪ Classify respiratory instrumentation mechanism and their advantages. (BL-2) ▪ Explain the significance of safety measures for medical equipment. (BL-2) ▪ Summarize the safety measure of equipment. (BL-2) ▪ Demonstrate the grounding mechanisms for medical equipment. (BL-2) 		
		Total hours:48 hours

Term work:			
Submit a report by visiting bio-medical department in the hospital highlighting the following information.			
1. Trouble shooting biomedical equipment.			
2. Usage of Ventilators.			
Content beyond syllabus:			
1. CT Scan.			
2. MRI Scan			
Self-Study:			
Contents to promote self-Learning:			
SNO	Topic	CO	Reference
1	Bio-Medical Instrumentation System	CO1	https://www.youtube.com/watch?v=iK-6q4nnmtA
2	Bio-electrodes	CO2	https://www.youtube.com/watch?v=49CWbXNJ3WE
3	ECG	CO3	https://www.youtube.com/watch?v=M8YycWnyckM&list=RDQMzFq-PsQsVuA&start_radio=1
4	EMG	CO4	https://www.youtube.com/watch?v=J7_LEOYuqwW
5	Ventilator Modes & Electrical safety	CO5	https://www.youtube.com/watch?v=Bz6nf-pnyIY https://www.slideshare.net/ishoney/medical-electrical-safety

Text Book(s):

1. Biomedical Instrumentation and Measurements – Leslie Cromwell and F.J. Weibell, E.A. Pfeiffer, PHI, 2nd Ed, 1980.
2. Medical Instrumentation, Application and Design – John G. Webster, John Wiley, 3rd Ed., 1998.
3. Bio-medical Instrumentation by M. Arumugam.

Reference Book(s):

1. Principles of Applied Biomedical Instrumentation – L.A. Geoddes and L.E. Baker, John Wiley, 1975.
2. Hand-book of Biomedical Instrumentation – R.S. Khandpur, TMH, 2nd Ed., 2003.
3. Biomedical Telemetry – Mackay, Stuart R., John Wiley, 2nd edition, 1968.

Online Resources:

1. https://www.academia.edu/39250912/Handbook_of_Second_Edition_Biomedical_Instrumentation
2. <http://fa.bme.sut.ac.ir/Downloads/AcademicStaff/3/Courses/4/Medical%20instrumentation%20application%20and%20design%204th.pdf>

Web References:

1. <https://www.slideshare.net/PrincyRandhawa/biomedical-instrumentation-60215990>
2. <https://www.youtube.com/watch?v=NP0Gb1a61Ug>
3. https://swayam.gov.in/nc_details/NPTEL
4. https://onlinecourses.nptel.ac.in/noc20_ee41/preview
5. <https://archive.nptel.ac.in/courses/108/105/108105064>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4019	WIRELESS COMMUNICATIONS							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisites:								
<ul style="list-style-type: none"> ✓ Signal processing techniques. ✓ Familiarity with mathematical tools like Linear Algebra, Vector spaces, Probability, Statistics and Random processes, Fourier Series and Transform. ✓ Digital communication systems basics. 								
Course Objectives:								
1.To introduce the concepts and techniques associated with Wireless Cellular Communication systems. 2. To familiarize with state of art standards used in wireless cellular systems. 3. To understand the emerging technologies of wireless and mobile communications and simulate them. 4.To describe signal processing in GSM. 5.To differentiate CDMA and GSM.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Apply cellular concepts to evaluate the signal reception performance in a cellular network and traffic analysis to design cellular network with given quality of service constraints. (BL:3)							
CO 2	Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium.(BL:4)							
CO 3	Distinguish various multiple access schemes used in wireless communication.[BL:4]							
CO 4	Analyze the measures to increase the capacity in GSM systems- sectorization and Spatial Filtering for Interference Reduction. [BL:4]							
CO 5	Design wireless communication systems with key 3G (e.g., CDMA) and 4G (OFDM) technologies (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2										3	3
CO2	3	2	2										3	3
CO3	3	2											3	3
CO4	3	2											3	3
CO5	3	2											3	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO CELLULAR CONCEPTS	Hours:08
Cellular concept-frequency reuse, channel assignment, hand off, Interference Trunking and grade of service, cell splitting, sectoring, microcell concept.		
At the end of the Module 1, students will be able to:		
1. Explain the frequency reuse concept.(BL:2) 2. Describe handoff mechanism in wireless communications.(BL:2) 3. Explain microcell concept. (BL:2)		

MODULE -2	RADIO WAVE PROPAGATION AND FADING	Hours:9
<p>Introduction to radio wave propagation-free space propagation model, ground reflection (2-ray) model, impulse response model of a multipath II channel, parameters of mobile multipath channels.</p> <p>Type of small scale fading, fading effect due to multipath time delay spread and Doppler spread, diversity technique for mobile wireless radio system.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1.Explain different types of fading techniques. (BL:2) 2.Explain parameters of multipath channels.(BL:2) 3.Describe diversity technique for mobile wireless radio system .(BL:2) 		
MODULE-3	MULTIPLE ACCESS TECHNIQUES	Hours:9
<p>Multiple access technique for wireless communication-FDMA, TDMA, III spread spectrum multiple access-FHMA, CDMA, Hybrid spread spectrum technique-space division multiple access- packet radio.</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Describe multiple access techniques for wireless communications. (BL:2) 2. Differentiate FDMA & CDMA. (BL:2) 3. Explain packet radio and packet radio protocols. (BL:2) 		
MODULE-4	GLOBAL SYSTEM FOR MOBILE (GSM)	Hours:7
<p>GSM-GSM network architecture, GSM channel type, frame structure for GSM,(signal processing in GSM-speech coding, channel coding, IV interleaving, ciphering, burst formatting, modulation, frequency hopping, demodulation).</p> <p>Authentication and security in GSM, GSM call procedures, GSM hand off procedures</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain signal processing in GSM. (BL:2) 2. Differentiate GSM call procedures and handoff procedures. (BL:2) 3. Explain frequency hopping techniques. (BL:2) 		
MODULE-5	CODE DIVISION MULTIPLE ACCESS (CDMA)	Hours:10
<p>CDMA digital cellular standards- Introduction, frequency and channel V specification, forward and reverse CDMA channel, CDMA call processing, soft hand off.</p> <p>Performance of a CDMA system, comparison of CDMA with GSM, digital cellular standards- DECT, PDC.</p>		
<p>At the end of the Module 5, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain CDMA call processing. (BL:2) 2. Describe the performance of CDMA system. (BL:2) 3. Compare CDMA and GSM. (BL:2) 		

Term work:

- Differentiate different types of wireless communication standards. .

Content beyond syllabus:

Ad-hoc and wireless sensor networks.
Cognitive radio and Software defined radio.

Self-Study:

Contents to promote self-Learning:

SN O	Topic	CO	Reference
1	Frequency reuse	CO1	https://youtu.be/BmOqhIYqp7o
2	Fading in wireless communication	CO2	https://youtu.be/nIata4K7egE
3	Multiple access techniques	CO3	https://youtu.be/TP8YRb3VH7M
4	GSM hand off procedures	CO4	https://youtu.be/GzFM2XzdpCo
5	Comparison of CDMA with GSM	CO5	https://youtu.be/7vd4ktB4ozk

Text Book(s):

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
3. T. S. Rappaport, "Wireless Communication, Principles & Practice", Dorling Kindersley (India) Pvt. Ltd., 2009.
4. G. L. Stuber, "Principles of Mobile Communications", 2nd Edition, Springer Verlag. 2007.

Reference Book(s):

1. Kamilo Feher, 'Wireless Digital Communication', Dorling Kindersley (India) Pvt Ltd.
2. R. L. Peterson, R. E. Ziemer & David E. Borth, "Introduction to Spread Spectrum Communication", Prentice Hall, 1995.
3. A. J. Viterbi, "CDMA- Principles of Spread Spectrum", Prentice Hall, 1995

Online Resources:

1. https://www.tutorialspoint.com/wireless_communication/index.htm
2. https://onlinecourses.nptel.ac.in/noc21_ee66/preview
3. <https://youtu.be/dWSJW-FB2ZU>

Web References:

1. <https://youtu.be/BmOqhIYqp7o>
2. <https://youtu.be/nIata4K7egE>
3. <https://youtu.be/TP8YRb3VH7M>
4. <https://youtu.be/GzFM2XzdpCo>
5. <https://youtu.be/7vd4ktB4ozk>

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4020	Fundamentals of Nano and Quantum Photonics							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite:								
Course Objectives:								
1. To understand the basic concepts of Electromagnetic Radiation, Diffraction limit of Light and Light- matter interaction. 2. To study the concepts of Plasmonics and Photonics in metallic nanostructures and nanoparticles. 3. To understand the unusual propagation of EM waves in 2-dimensional periodic potential. 4. To Analyze Nanofabrication techniques of photonic devices. 5. To Analyze Quantum harmonic oscillator, Phasor diagrams and quadratures in canonical Quantization.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basic concepts of Electromagnetic Radiation, Diffraction limit of Light and Light-matter interaction. (BL-2)							
CO 2	Illustrate the concepts of Plasmonics and Photonics in metallic nanostructures and nanoparticles.							
CO 3	Explain the unusual propagation of EM waves in 2-dimensional periodic potential. (BL-2)							
CO 4	Analyze Nanofabrication techniques of photonic devices. (BL-4)							
CO 5	Analyze Quantum harmonic oscillator, Phasor diagrams and quadratures in canonical Quantization. (BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	3	2	2									2	2
CO2	3	3	2										2	
CO3	3	2	2										1	2
CO4	3	3	3										1	1
CO5	3	3	2										2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO NANO ELECTRONICS	9 Hrs
Introduction to nano-photonics, Review of electro-magnetics, Maxwell equations and Wave optics, Electromagnetic radiation and evanescent waves, the Diffraction limit of light, Light-matter interaction - Dielectric function, Kramers- Kronig relationship, Drude-Lorentz and drude models, Inter-band and Intra-band transitions.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> To understand the concepts of Electro-magnetics, Maxwell equations and wave optics. (BL-2) To understand Electromagnetic radiation and Diffraction limit of light. (BL-2) To explain Dielectric function, Kramers-Kronig relationship. (BL-2) 		
MODULE -2	PLASMONICS AND PHOTONICS	10 Hrs

Plasmonics - Quasi-static limit, Nano-particle as a plasmonic atom, Size-dependent absorption and scattering, Coupled nano-particles, Plasmon hybridization, Dielectric nano-photonics – Photonics in 2D, 1D and 0D semiconductors, Selection rules, Photonic density of states, Electromagnetic waves in 1D periodic potential - Scattering from planar interfaces, Photonic band-gaps, Rayleigh anomalies.

At the end of the Module 2, students will be able to:

1. To explain Quasi-static limit and nano-particle as a plasmonic atom in Plasmonics.(BL-2)
2. To understand Photonics in 2D, 1D and 0D semiconductors. (BL-2)
3. To explain Electromagnetic waves in 1D periodic potential. (BL-2)

MODULE-3	EM WAVES IN 2D PERIODIC POTENTIAL	10 Hrs
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Electromagnetic waves in 2D periodic potential - Electric and magnetic meta-materials, Negative refractive index, Super-lens and hyper-lens, Plasmonic and Dielectric meta-surfaces, Light emitting(active) meta-materials - Optical gain, Radiative and non-radiative transitions, Amplified emission, Lasing threshold, Nano-lasers.

At the end of the Module 3, students will be able to:

1. To explain Electromagnetic waves in 2D periodic potential.(BL-2)
2. To understand Super-lens and hyper-lens, Plasmonic and Dielectric meta-surfaces. (BL-2)
3. To explain Light emitting(active) meta-materials - Optical gain, Radiative and non-radiative transitions, amplified emission, Lasing threshold, Nano-lasers. (BL-2)

MODULE-4	NANO-FABRICATION OF PHOTONIC DEVICES	8 Hrs
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Nanofabrication of photonic devices – Examples from recent literature on nano-photonic devices, Classical to quantum nano-photonics (small dimensions + low intensity/few photons), Photon statistics - photonics in the quantum regime, Classification of light by photons statistics, Super-poissonian and sub-poissonian light, Photo-detection, Photon anti-bunching - Hanbury-Brown twiss interferometer, Second-order correlation function, Photon bunching and anti-bunching, Single-Photon sources.

At the end of the Module 4, students will be able to:

1. To analyze the nanofabrication of photonic devices. (BL-4)
2. To understand the concepts of photon statistics.(BL-2)
3. To explain photon bunching and anti-bunching. (BL-2)

MODULE-5	CANONICAL QUANTIZATION	11 Hrs
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Canonical quantization - Quantum harmonic oscillator, Phasor diagrams and quadratures, Vacuum fluctuations, Coherent states, Number-phase uncertainty, Resonant light-atom interactions - time-dependent Schrodinger equations, Strong and weak coupling, Rabi-oscillations.

At the end of the Module 5, students will be able to:

1. To Analyze Quantum harmonic oscillator, Phasor diagrams and quadratures in canonical Quantization. (BL-4)
2. To understand coherent states, Number-phase uncertainty of canonical Quantization. (BL-2)
3. To understand Resonant light-atom interactions. (BL-2)

Total hours: 48 hours

Term work:

1. Literature Review & Tutorial questions.
2. Study canonical quantization and submit report on same.

Content beyond syllabus:

1. Electromagnetic wave propagation in 2-Dimensional Photonic crystals.
2. Plasmonics Technology.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Nano Electronics	CO1	https://youtu.be/nnq5asbB_Ow
2	Electromagnetic waves in 1D periodic potential	CO2	https://youtu.be/4O0A1HFilOo
3	Meta materials	CO3	https://youtu.be/JH3YbgzUL-U
4	Nano fabrication of Photonics	CO4	https://youtu.be/zeoDhhOh954
5	Canonical quantization	CO5	https://youtu.be/FCAiLamqbsQ

Text Book(s):

1. Optical Meta materials: Fundamentals and Applications. Wenshan Cai and Vladimir Shalaev, Springer (2010).
2. Introduction to Nanophotonics, Sergey V. Gaponenko, Cambridge University Press (2010).

Reference Book(s):

1. Nano and quantum optics -An introduction to basic principles and theory. Ulrich Hohenester. 1st edition, Springer (2020).
2. Quantum optics: an introduction, Fox, M. 1st edition, Oxford University Press (2006).

Online Resources:

1. <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiJuPyAkuf6AhUUiYKHQEHBqMQFnoECBIOAQ&url=https%3A%2F%2Fwww.photonics.com%2F&usg=AOvVaw3c4O22Fjfqg2URDZH9MzN2>

Web References:

1. <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjQmvXEku6AhXJBbcAHf69D4QQFnoECD4QAO&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FNanophotonics&usg=AOvVaw3C5MYZQM00QopzhWeXE4aG>

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4021	DIGITAL IMAGE PROCESSING							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Signals and Systems, Digital communication								
Course Objectives:								
1. To Recall the digital image fundamentals and learn various image transforms 2. To perform image enhancement techniques in spatial and frequency domain 3. To Understand image degradation model and Compare three color models. 4. To Analyze various image compression techniques 5. To Analyze the image segmentation and representation techniques.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Recall the digital image fundamentals and Explain various image transforms (BL:1&BL:2)							
CO 2	Implement basic image processing techniques(spatial & frequency domain) (BL:3)							
CO 3	Summarize image degradation model, algebraic approach, Inverse filtering, Least mean square filters (BL:2) Compare three colour models (BL: 4)							
CO 4	Analyze different image compression techniques (BL:4)							
CO 5	Analyze the image segmentation and representation techniques (BL:4)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	
CO2	1	2		1										
CO3	3	2	1	1	1									
CO4	1	1			1								1	
CO5	1	1		1	1								1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO IMAGE PROCESSING & IMAGE TRANSFORMS	10 Hrs
Fundamentals of image processing: Image acquisition, Image sampling and quantization, Relationships between pixels, Image geometry, Gray level transformations, Histogram processing: Histogram equalization. Image transforms: 2-D DFT, Properties. Walsh transform, Hadamard transform, Discrete cosine transform, Haar transform, Slant transform, KL transform, Comparison of different transforms.		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> Understand the basic components that constitutes an image. (BL-2) Understand various image transformation techniques (BL-2) Compare different transforms (BL-4) 		

MODULE -2	IMAGE ENHANCEMENT	10 Hrs
<p>Image enhancement: Arithmetic and logical operations, Point processing, Image smoothing and sharpening filters in spatial domain(by spatial domain methods), Image smoothing and image sharpening filters in frequency domain, Homo-morphic filter (by frequency domain methods), comparison of filters in frequency domain and spatial domain.</p> <p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Compute arithmetic and logic operations (BL:3) 2. Translate image enhancement techniques in spatial and frequency domain (BL:2) 3. Analyze performance of communication systems in the presence of noise. (BL:4) 		
MODULE-3	IMAGE RESTORATION	9 Hrs
<p>Image restoration: Image degradation/Restoration model, Noise models, Restoration in the presence of noise only-spatial filtering - mean, Order statistic and adaptive filters. Estimating the degradation function, Inverse filtering, Weiner filtering, Constrained least squares filtering.</p> <p>Color image processing: Color models–RGB, YUV, HSI; Color transformations– formulation, Color complements, Color image smoothing and sharpening.</p> <p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Summarize image restoration using degradation model (BL:2) 2. Understand least mean square filters (BL:2) 3. Compare three(RGB, YUV and HIS) color models (BL:4) 		
MODULE-4	IMAGE COMPRESSION	9 Hrs
<p>Image compression: Types of redundancy, Lossless compression: Variable length coding, LZW coding, Bit plane coding, Predictive coding- DPCM. Lossy compression: Transform coding, Basics of image compression standards: JPEG, JPEG 2000.</p> <p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain various image compression techniques. (BL:2) 2. Differentiate lossless and lossy compression techniques. (BL:2) 3. Recall image compression standards. (BL:1) 		
MODULE-5	IMAGE SEGMENTATION & MULTI-RESOLUTION IMAGE PROCESSING	10 Hrs
<p>Image segmentation: Detect ion of discontinuities- Point, Line and edge Detection, Thresholding-global thresholding, Adaptive thresholding, Region based segmentation.</p> <p>Wavelets and multi-resolution image processing: Uncertainty principles of Fourier transform, Time-frequency localization, Continuous wavelet transforms, Wavelet bases and multi-resolution analysis, Wavelets and sub band filter banks, Wavelet packets.</p> <p>At the end of the Module 5, students will be able to:</p> <ol style="list-style-type: none"> 1. Demonstrate the image segmentation (BL:3) 2. Identify point, line and edge detection techniques (BL:1) 		

3. Analyze wavelets and multi-resolution image processing. (BL:4)

Total hours: 48 hours

Term work:

1. Develop & Design Requirements for specifications of digital image processing in Social Websites.

Content beyond syllabus Advanced wavelet coding, video image processing and lays the foundation for understanding current and future communication standards.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Image Sampling and Quantization	CO1	https://www.geeksforgeeks.org/difference-between-image-sampling-and-quantization/
2	Image smoothening and sharpening	CO2	http://fy.chalmers.se/~romeo/RRY025/notes/lec3.pdf
3	Image degradation model	CO3	https://www.owl.net.rice.edu/~elec539/Projects99/BACH/foj2/intro.html https://www.researchgate.net/figure/Image-Degradation-Model-The-degraded-image-in-the-spatial-domain-is-given-by-gx-y_fig1_325316655
4	Lossless and lossy image compression techniques	CO4	https://www.techtarget.com/whatis/definition/lossless-and-lossy-compression#:~:text=With%20lossless%20compression%20every%20bit,certain%20information%2C%20especially%20redundant%20information.
5	Image segmentation	CO5	https://datagen.tech/guides/image-annotation/image-segmentation/

Text Book(s):

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004.

Reference Book(s):

1. Rafael C. Gonzalez, Richard E woods and Steven L. Eddins, Digital Image processing using MATLAB”, Tata McGraw Hill, 2010.
2. William K. Pratt, “Digital Image Processing, John Wiley, 3rd Edition, 2004.
3. S jayaraman, S Esakkirajan, T Veerakumar, Digital Image processing”, Tata McGraw-Hill.

Online Resources:

1. <https://nptel.ac.in/courses/117105079>
2. <https://www.tutorialspoint.com/dip/>
3. <http://textofvideo.nptel.ac.in//117105135/lec1.pdf>
4. <https://www.digimat.in/nptel/courses/video/117105135/L01.html>

Web References:

1. https://en.wikipedia.org/wiki/Image_segmentation
2. <https://www.upgrad.com/blog/image-segmentation-techniques/>
3. <https://nptel.ac.in/courses/117105135>
4. https://onlinecourses.nptel.ac.in/noc19_ee55/preview
5. http://poseidon.csd.auth.gr/LAB_PUBLICATIONS/Books/dip_material/chapter_4/chap4en.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4022	Low Power VLSI Design							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VII	3	0	0	48	3	40	60	100
Pre-requisite: Electron Devices, Fundamentals in digital design, VLSI Design.								
Course Objectives:								
1. To identify low-power design approaches, power estimation and analysis.								
2. To study different types of metal–oxide–semiconductor (MOS) inverters.								
3. To analyze the sources of low-power and to study different voltage scaling techniques for low power.								
4. To analyze different low-power techniques using switched capacitance.								
5. To get familiar with CAD tools and to analyze different techniques for minimizing leakage power techniques.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Identify the sources of power consumption and understand MOS transistor characteristics (BL-2)							
CO 2	Understand different low-power design approaches, power estimation and analysis (BL-2)							
CO 3	Design low power adder circuits and systems.(BL-3)							
CO 4	Design low power multiplier circuits and systems. (BL-3)							
CO 5	Understand different types of SRAMs/DRAMs for low power applications and study modern CAD tools with reduction techniques. (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2											3	
CO2	3	1	2		1								2	
CO3	3	2	2		1	1							2	1
CO4	3	2	2		1	1							3	2
CO5	3	2	2		1	1							2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	Introduction & MOS Transistor	10hours
Introduction, structure of MOS Transistor, Modes of operation of MOS Transistor, Electrical characteristics of MOS Transistors, MOS Transistors as a switch, MOS inverters and Combinational circuits, Sources of Power dissipation in CMOS.		

At the end of the Module 1, students will be able to:		
1.Recall fundamentals of low power design concepts to classify various power dissipation mechanisms (BL1)		
2 .Understand the impact of power on system performance and reliability.(BL2)		
3. Understand the behavior of MOS transistor and its characteristics. (BL2)		
MODULE -2	Low-Power Design Approaches	9hours
Introduction, short-circuit power dissipation, switching power dissipation, glitching power dissipation, leakage power dissipation. Supply voltage scaling techniques and minimizing switching capacitance techniques for low power.		
At the end of the Module 2, students will be able to:		
1. Identify the sources of power dissipation in digital IC systems. (BL2)		
2. Understand importance of Voltage scaling.(BL2)		
3. Illustrate the various threshold voltage techniques based on low power.(BL2)		
4. Compare Pipeline and Parallel Processing Approaches.(BL2)		
5. Understand the concept of Switches capacitance Minimization Approaches.(BL2)		
MODULE-3	Low-Voltage Low-Power Adders	10hours
Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low Power Design Techniques –Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.		
At the end of the Module 3, students will be able to:		
At the end of the Module 3, students will be able to:		
1.Understand the importance of Standard Adder Cells in CMOS Architecture.(BL2)		
2. Demonstrate the various CMOS Adder Architectures. (BL2)		
3. Apply the Low-Voltage Low-Power Logic Styles for VLSI circuits. (BL3)		
MODULE-4	Low-Voltage Low-Power Multipliers	10hours
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.		
At the end of the Module 4, students will be able to:		
1. Understand the importance of various low- voltage and low-power power multipliers.(BL2)		
2. Build the Low-Voltage Low-Power Multipliers.(BL3)		
3. Compare different types of low power multipliers.(BL2)		
MODULE-5	Low-Voltage Low-Power Memories & CAD tools	9hours
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM, CAD tools for low power VLSI circuits.		
At the end of the Module 5, students will be able to:		
1. Demonstrate the working principle and operation of different Memories.(BL2)		
2. Understand of Low-Voltage Low-Power Memories and Basics of DRAM.(BL2)		
3. Develop low power adders, multipliers and memories for efficient design of systems.(BL3)		
4. Study CAD tools for low power.(BL2)		

Content beyond syllabus:

1. Adiabatic switching
2. Adiabatic charging
3. Adiabatic amplification

Self-Study:**Contents to promote self-Learning:**

SNO	Topic	Reference
1	Introduction & Fundamentals of Low Power VLSI Design	https://www.youtube.com/watch?v=PycBaZyy6K0 https://archive.nptel.ac.in/courses/106/105/106105034/
2	MOS Inverters & Combinational Circuits	https://www.nptelvideos.com/lecture.php?id=6372
3	Sources of Power Dissipation	https://www.nptelvideos.com/lecture.php?id=6376
4	Minimizing Switched Capacitance	https://www.nptelvideos.com/lecture.php?id=6385
5	Minimizing Leakage Power & CAD Tools	https://www.nptelvideos.com/lecture.php?id=6390 https://www.youtube.com/watch?v=gkEJmMFKtzE&list=PLTEh-62_zAfHmJE-pcJgREKiKyPSgjkxj&index=18

Text Books:

1. Ajit Pal, Low Power VLSI Circuits and Systems, Springer, first edition, 2015. <https://doi.org/10.1007/978-81-322-1937-8>.
2. Kaushik Roy, Sharat C. Prasad, Low Power CMOS VLSI Design, Wiley India 1 edition (January 1, 2009).
3. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering, 1st edition 2004
4. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002

Reference Books:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
2. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2003.
3. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
4. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.
5. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.

Online Resources:

1. <https://www.youtube.com/watch?v=TFOO1JAll2Y> (Low Power VLSI Design)
2. <https://archive.nptel.ac.in/courses/106/105/106105034/> (Low Power VLSI systems)

Web References:

1. <http://leda.elfak.ni.ac.rs/education/projektovanjeVLSI/predavanja/>
2. <https://www.egr.msu.edu/classes/ece410/salem/files/s16/lectures/>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4023	ADVANCED EMBEDDED LOGIC DESIGN							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VII	3	0	0	48	3	40	60	100
Pre-requisite: Microprocessor and microcontrollers								
Course Objectives:								
<ol style="list-style-type: none"> To illustrate the significance of embedded system and its hardware. To compare various board memory devices based on performance. To understand the architecture of the MSP430. To summarize various digital input and output ports. To apply interfacing techniques for MSP430 communication peripherals. To interpret the case study of MSP 430. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Illustrate the significance of embedded system and its hardware. (BL-02)							
CO 2	Compare various board memory devices based on performance. (BL-04)							
CO 3	Understand the architecture of the MSP430. (BL-02)							
CO 4	Summarize various digital input and output ports. (BL-02)							
CO 5	Apply interfacing techniques for MSP430 communication peripherals. (BL-03)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1				2	1				2	1	2	2	
CO2	2				2	1								
CO3			2	1	2	1			2					2
CO4	1													
CO5			1	1						1	1	2		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Introduction to Embedded Electronic Systems and Microcontrollers	10hrs
An Embedded System-Definition, Embedded System Design and Development Life Cycle, An Introduction to Embedded system Architecture, The Embedded Systems Model, Embedded Hardware:The Embedded Board and the von Neumann Model, Embedded Processors: ISA Architecture Models, Internal Processor Design.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain the model of embedded systems. (BL-02) Summarize the hardware of embedded system. (BL-02) Understand the concept of processor performance. (BL-02) 		
MODULE -2	Board Memory	10 hrs
Memory Management of External Memory and Performance, Approaches to Embedded Systems. Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Small Microcontrollers Memory, Embedded Software, Introduction to small microcontroller (MSP430).		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the types of memories available. (BL-02) 2. Summarize the memory management of external memory and its performance. (BL-02) 3. Understand the approaches to embedded systems. (BL-02) 4. Compare various board memory devices based on performance. (BL-04) 		
MODULE-3	MSP430 – I	10hrs
MSP430 Processor, Functions, Interrupts, and Low-Power Mode: Functions and Subroutines, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the MSP 430 processor. (BL-02) 2. Demonstrate Memory and Memory Organization. (BL-02) 3. Understand the concept of Interrupts and Interrupt Service Routines. (BL-02) 		
MODULE-4	MSP430 – II	8 hrs
Digital Input, Output, and Displays: Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Interface between Systems, Driving Heavier Loads, Liquid Crystal Displays, Simple Applications of the LCD.		
Timers: Watchdog Timer, Timer_A, Timer_A Modes, Timer_B,Timer_B Modes, Setting the Real-Time Clock, State Machines.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the various digital inputs and outputs. (BL-02) 2. List the applications of LCD's. (BL-01) 3. Understand the simple applications of the LCD. (BL-02) 4. Summarize the watch dog timer with its modes. (BL-02) 		
MODULE-5	MSP430 Communication	10hrs
Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, A Thermometer Using SPI Modes, Inter-integrated Circuit Bus(I ² C) and its operations, State Machines for I ² C Communication, A Thermometer Using I ² C, Asynchronous Serial Communication, Asynchronous Communication with the USCI_A.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. List the Communication Peripherals in the MSP430(BL-01) 2. Study the SPI with the USCI(BL-01) 3. Apply interfacing techniques for MSP430 communication peripherals(I2C, SPI, UART). (BL-03) 		
Total hours:		43 hours

Term work: Real-time operation implementation aspects for relevant systems, Able to use best methodologies for validation and optimization of developed embedded systems.

Content beyond syllabus:

1. The Microprocessor System Architecture
2. The Computer Multiprocessor System

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
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1	Design and Development Life Cycle	https://www.youtube.com/watch?v=mH-Nc5kvyQQ
2	Anatomy of a Typical Small Microcontroller	https://www.edn.com/intro-to-embedded-systems-part-2-anatomy-of-a-typical-small-microcontroller/
3	Emulated Instructions	http://www.crectirupati.com/sites/default/files/lecture_notes/final%20ES.pdf
4	Liquid Crystal Displays	https://www.youtube.com/watch?v=62IGXezchjs
5	Inter-integrated Circuit Bus(I ² C)	https://www.youtube.com/watch?v=7MZ-a-unAU8
6	UART Communication	https://www.youtube.com/watch?v=Mq8zaM-3t10

Text Book(s):

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd.Publications, 2005.
2. John H. Davies "MSP430 Microcontroller Basics", Elsevier Ltd Publications, Copyright 2008.
3. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.

Reference Book(s):

1. Manuel Jiménez Rogelio, Palomera Sidorou Couvertier "Introduction to Embedded Systems Using Microcontrollers and the MSP430" Springer Publications, 2014.
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wiley & Sons Inc.2002.
3. Arnold S Burger, "Embedded System Design", CMP Books, 2002.
4. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.

Online Resources:

1. <https://www.youtube.com/watch?v=SiDU78vHsko>
2. <https://training.ti.com/msp430-workshop-series-5-12-interrupts>
3. <https://microcontrollerslab.com/uart-serial-communication-with-msp430-microcontroller/>

Web Resources:

1. <https://www.nxp.com/docs/en/reference-manual/M68HC05TB.pdf>
2. <https://www.ijedr.org/papers/IJEDR1303026.pdf>
3. https://www.egr.msu.edu/classes/ece480/capstone/fall09/group03/AN_balachandran.pdf
4. https://www.tutorialspoint.com/embedded_systems/es_processors.html

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4024	VIRTUAL INSTRUMENTATION							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. To understand what is Virtual instrumentation and to realize the architecture of VI.
2. To familiarize with the VI software and learn programming in VI.
3. To study various Instrument Interfacing and data acquisition methods.
4. To understand various analysis tools in LabVIEW.
5. Develop programs for Process control applications.

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

CO 1	Explain the evolution, advantages, techniques, architecture of VI.(BL-2)
CO 2	Design VI for the given specifications using programming structures. (BL-6)
CO 3	Explain the significance of data acquisition. (BL-2)
CO 4	Classify common instrument interfaces with industrial applications. (BL-2)
CO 5	Explain the analysis tools in LabVIEW. (BL-2)

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												2	
CO2	2	2	2		2							2	2	2
CO3	2												2	2
CO4	2				2								2	
CO5	2												2	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
Module-1	INTRODUCTION	8h
Historical perspective – Need of VI – Advantages of VI – Define VI – Block diagram & Architecture of VI – Data flow techniques – Graphical programming in data flow – Comparison with conventional programming. (8h)		
At the end of the Module 1, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain virtual instrument, VI block diagram and architecture.(BL-2) ▪ Summarize the data flow techniques. (BL-2) ▪ Compare the differences between conventional and graphical programming. (BL-2) 		
Module-2	PROGRAMMING STRUCTURES OF VI	10h
VIS and sub-VIS – Loops and charts – Arrays – Clusters – Graphs – Case & sequence structures – Formula nodes – Local and global variable – String & file input. .(8h)		
At the end of the Module 2, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain the programming structures of VI. (BL-2) ▪ Design Virtual Instruments. (BL-6) ▪ Explain the VI's and Sub VI's. (BL-2) 		

Module-3	DATA ACQUISITION	8h
DIO – Counters and timers – PC Hardware structure – Timing – Interrupts – DMA – Software and Hardware Installation – GPIB/IEEE 488 concepts – Embedded system buses – PCI – EISA – CPCI. .(8h)		
At the end of the Module 3, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain Data acquisition concepts. (BL-2) ▪ Demonstrate hardware and software installation. (BL-2) ▪ Classify embedded buses. (BL-2) 		
Module-4	INTERFACING	10h
Current loop – RS 232C/RS 485 – Interface basics: USB – PCMCIA – VXI – SCXI – PXI – networking basics for office and industrial application VISA and IVI – Image acquisition and processing – Motion Control – DMM – Waveform generator. .(8h)		
At the end of the Module 4, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain the interface basics of VI. (BL-2) ▪ Explain process of image acquisition and processing. (BL-2) ▪ Define VISA and its application. (BL-1) 		
Module-5	INDUSTRIAL APPLICATIONS	12h
Fourier transforms – Power spectrum – Correlation methods – Windowing and filtering- PID controller tool box. Pressure control system – Flow control system – Level control system– Temperature data acquisition system – Motion control employing stepper motor.		
At the end of the Module 6, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain the industrial applications of VI. (BL-2) ▪ Summarize PID controller toolbox (BL-2) ▪ Demonstrate the data acquisition methodologies. (BL-2) 		
Total hours:		50 hours

Term work:

Develop the following virtual instruments using LabVIEW.

1. Verification of Arithmetic Operations.
2. Verification of Half Adder and Full adder.
3. Program to find Addition of First n natural numbers using for and while loop.
4. Implementation of Array functions.
5. Program for implementing Seven segment display.

Content beyond syllabus:

1. Applications of VI in engineering disciplines.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Data flow programming	CO1	https://www.youtube.com/watch?v=PqxStfwjQoQ
2	Formula Node	CO2	https://www.youtube.com/watch?v=6sxDkAOGQ7w
3	Data Acquisition	CO3	https://www.youtube.com/watch?v=Yi3SGjk3WSs
4	Image Acquisition	CO4	https://www.youtube.com/watch?v=AOCcj43A6Y
5	PID controller	CO5	https://www.youtube.com/watch?v=YQVHnDW-rTA

Text Book(s):

1. Dr. Sumathi. S and Prof. Surekha. P, “LabVIEW Based Advanced Instrumentation Systems”, 2nd edition, 2007.
2. Gary Johnson, “LabVIEW Graphical Programming”, McGraw Hill, 2006.
3. Jovitha Jerome , Virtual Instrumentation Using Labview, PHI

Reference Book(s):

1. Lisa .K, Wells and Jeffrey Travis, “LABVIEW for Everyone”, Prentice Hall, 2009.
2. Skolkoff, “Basic concepts of LABVIEW 4”, PHI, 1998.
3. Gupta. S, Gupta. J.P, “PC Interfacing for Data Acquisition and Process Control”, ISA, 1994.
4. Amy. L.T, “Automation System for Control and Data Acquisition”, ISA, 1992.

Online Resources:

1. <https://www.electronics-notes.com/articles/test-methods/labview/g-programming.php>

Web References:

1. <http://www-ee.eng.buffalo.edu/faculty/paololiu/edtech/roaldi/tutorials/labview.htm>
2. <https://www.labviewmakerhub.com/doku.php?id=learn:tutorials:labview:basics>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4025	SIGNAL PROCESSING FOR mm WAVE COMMUNICATION FOR 5G AND BEYOND							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
MODULE	1	2	3	4	5	Total		
No of Hr's	08	10	10	10	10	48		
Pre-requisite:								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand wireless channel- a ray tracing model. 2. To understand the various channel related concepts. 3. To study the antenna array processing concept. 4. To describe the hybrid beam forming concept. 5. To outline the parameter estimation in mm wave system. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Understand the wireless channel model(BL-2)							
CO 2	Understand the channel related concepts(BL-2)							
CO 3	Study the concept of antenna array processing. (BL-2)							
CO 4	Explain the concept of hybrid beamforming. (BL-2)							
CO 5	Analyze various parameters in mm wave system. (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2											1	
CO2	2	3	1										2	
CO3	2	3	1										2	1
CO4	2	2	1									1	1	
CO5	2	3	1										2	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO 5G	08 Hrs
Wireless Channel–A ray tracing model-Part-I (With an outline on modern modem structure), Wireless Channel–A ray tracing model.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1.Explain A ray tracing model(BL-02) 2.Explain wireless channel(BL-01) 		
MODULE -2	CHANNEL PARAMETERS	10 Hrs
Understanding of various channel related parameter statistics. Narrow band and broadband aspect, mmWave channel model, Understanding angle of arrival (AoA) and angle of departure (AoD) concept, understanding channel gain.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the channel related parameter statistics. (BL-02) 2. Explain the mm wave channel model (BL-02) 3. Understand channel gain. (BL-02) 		
MODULE-3	BEAMFORMING	10 Hrs
Introduction of single antenna beam forming in mmWave, an antenna array processing concept, Details of beam forming in mmWave: Concept of antenna many fold vector, beam parameters, efficiency of beams pattern.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain single antenna beam forming in mm wave. (BL-02) 2. Understand the concept of antenna array processing (BL-02) 3. Calculate beam parameters and efficiency (BL-03) 		
MODULE-4	HYBRID FORMING	10 Hrs
Hybrid beam forming concept. Beam forming in MIMO system Part-I (Pre-coder, phase shifter, equalizer concepts), Hybrid beam forming concept. Beam forming in MIMO system Part-II (Optimization of design parameters), MIMO-OFDM with mmWave beam forming.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the concept of hybrid beam forming (BL-02) 2. Summarize the MIMO system (BL-02) 3. Explain the MIMO-OFDM (BL-02) 		
MODULE-5	mmWAVE SYSTEM	10 Hrs
Parameter estimation in mmWave system (Mainly LMMSE based), Introduction of impairments and a basic analysis in mmWave system		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Describe the parameters of mm wave system (BL-2) 2. Analyze the mm wave system (BL-02) 		
Total hours:		48 hours

Term work:		
<ol style="list-style-type: none"> 1. Submit report on advantages of 5G 2. Submit the survey report applications of millimeter wave communication. 3. Submit the various accessing technologies adopted in 5G communication. 		
Content beyond syllabus:		
<ol style="list-style-type: none"> 1. Evaluation methodology 2. New challenges in the 5G modeling 		
Self-Study:		
Contents to promote self-Learning:		
SNO	Topic	Reference
1	Introduction to 5G	https://www.tutorialspoint.com/5g/5g_introduction.htm
2	5G Architecture	http://www.emfexplained.info/?ID=25916
3	Beam forming in mm wave	https://www.5gmmwave.com/5g-mmwave/beamforming-in-5g-mmwave-radios/

4	Beamforming in MIMO system	https://www.electronics-notes.com/articles/antennas-propagation/mimo/antenna-beamforming.php
5	Parameter estimation in mm wave system	https://www.sciencedirect.com/science/article/abs/pii/S0165168420302589

Text Book(s):

1. Fundamental of Wireless Communication By David Tse, Pramod Viswanathan
2. Millimeter Wave communication Systems By Kao-Cheng Huang, Zhaocheng Wang

Reference Book(s):

1. T. S. Rappaport, Millimeter Wave Wireless Communications

Online Resources:

1. https://www.youtube.com/watch?v=Pa1Y_6FwmAg
2. <https://www.youtube.com/watch?v=A1n5Hhwtz78>
3. <https://www.youtube.com/watch?v=TC19gMQ6azE>

Web References:

- 1 <https://ieeexplore.ieee.org/document/9700480>
- 2 <https://www.youtube.com/watch?v=aPR8a7pxpCU>
- 3 https://link.springer.com/chapter/10.1007/978-3-030-30859-9_28?gclid=EAIaIQobChMI2_yD-en1-gIVjX8rCh1pqQVrEAAyAAEgIxn_D_BwE

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4026	HIGH SPEED ELECTRONICS							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
VII	3	0	0	48	3	40	60	100
Module 1	Module 2	Module 3	Module 4	Module 5	Total			
8H	10H	10H	10H	10H	48H			
Pre-requisite: Basic knowledge on semiconductor materials, VLSI Design.								
Course Objectives:								
<ol style="list-style-type: none"> 1. Study the fundamental properties and models of high-speed signals and interconnects 2. To give exposure on the band diagrams of HBT & hetero junction devices 3. Explain the characteristics of hetero-junction devices 4. Understand the applications of high speed transistors 5. Demonstrate the fabrication techniques of high speed electronic devices. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the characteristics of semiconductor materials and structure of metal semiconductor.(BL-02)							
CO 2	Explain Structure and band diagram of homojunction devices.(BL-02)							
CO 3	Compare the characteristics of MOSFET and high speed Heterojunction MOSFET.(BL-02)							
CO 4	Explain small signal switching model of high speed devices.(BL-02)							
CO 5	Analyze the high gain frequency performance of HBTs.(BL-04)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1									1		
CO2	2	2	1									1	2	2
CO3	2	3	2									1		
CO4	2	2	2	1								1		
CO5	2	2	2	1								1		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Semiconductor Material Characteristics	8H
Review of Crystal Structure: Crystal structure of important semiconductors (Si, GaAs, InP) , electrons in periodic lattices ,energy band diagram, carrier concentration and carrier transport phenomenon, electrical - optical - thermal and high field properties of semiconductors.		
At the end of the Module 1, students will be able to demonstrate knowledge in		
<ol style="list-style-type: none"> 1. Recall the importance of semiconductor materials.(BL-01) 2. Understand the energy band diagram of semiconductor. (BL-02) 3. Explain the carrier concentration and carrier transport phenomenon. (BL-02) 4. Understand the high field properties of semiconductors. (BL-02) 		
MODULE -2	Homojunction Devices	10H
Homojunction Devices (BJT and FET): Structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the Homojunction devices structures. (BL-02) 2. Explain the band diagram of HBT. (BL-02) 3. Compare the characteristics of Homojunction devices with semiconductor. (BL-02) 		
MODULE-3	MOS Devices	10H
MOS Diode: Structure ,band diagram ,operation , C–V characteristics , effects of oxide charges, avalanche injection , high field effects and breakdown, Heterojunction Based MOSFET: Band diagram , structure , operation ,I–V and C–V characteristics (analytical expressions) ,MOSFET breakdown and punch through ,subthreshold current ,scaling down,Alternate High k-dielectric Materials: HF–MOSFETs , SOI MOSFET , buried channel MOSFET ,charge coupled devices.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the effect of oxide charges. (BL-02) 2. Explain the importance of high field effects.(BL-02) 3. Study the operation and characteristics of Heterojunction based MOSFET. (BL-02) 4. Compare various MOSFET Properties. (BL-02) 		
MODULE-4	Advanced Devices	10H
HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure , band diagram ,operation , I–V and C–V characteristics (analytical expressions) ,small signal switching models , benefits of heterojunction transistor for high speed applications.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Define HBT and HEMT Devices.(BL-01) 2. Apply the knowledge of semiconductors to study HBT and HEMT structure. (BL-02) 3. Understand the characteristics and operation of Advanced devices. (BL-02) 4. List the high speed applications. (BL-01) 		
MODULE-5	Hetero junction Bipolar transistors (HBTs) structures	10H
Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices, High Frequency resonant ,tunneling devices, Resonant, tunneling hot electron transistors		

Term work:

1. Study about high speed digital circuits
2. Compare semiconductor and high speed semiconductor electronic devices.

Content beyond syllabus:

1. High-speed signalling consideration: power dissipation heat, signal propagation, and termination
2. Chart preparation on hetero-junction devices mentioning its important features.

Self-Study:

Contents to promote self-Learning:

SN O	Topic	Reference
1	Semiconductor Material Characteristics	https://www.youtube.com/watch?v=OTDVov_kw6A
2	Homo Junction Devices	https://www.youtube.com/watch?v=5FjSxpf8uel
3	MOS Devices	https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7006653 https://www.youtube.com/watch?v=U0XbqKQoesY
4	Advanced Devices	https://www.youtube.com/watch?v=T23rtMmFOik&list=PL804EBBC9541F0D5A&index=8
5	Hetero junction Bipolar transistors (HBTs) structures	https://www.youtube.com/watch?v=iMZ8WVrInVw&list=PL804EBBC9541F0D5A&index=20
6	Fabrication and Characterization Techniques	https://www.youtube.com/watch?v=o9uRmL38R6A

Text Book(s):

1. Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices: Modeling and Technology", Prentice Hall of India, 2004.
2. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley and Sons, 2008.
3. S. M. Sze, "Physics of Semiconductor Devices", 3rd edition, John Wiley and Sons, 2007
4. J. Singh, "Semiconductor Devices: Basic Principles", John Wiley and Sons, 2007

Reference Book(s):

1. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications Wiley
2. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons,
3. David K. Ferry, Ed., Gallium Arsenide Technology, Howard W. Sams & Co., 1985
4. Avishay Katz, Indium Phosphide and Related materials: Processing, Technology and Devices, Artech House, 1992.
5. S.M. Sze, High Speed Semiconductor Devices, Wiley (1990) ISBN 0-471-62307-5

Online Resources:

1. <http://nptel.iitm.ac.in/video.php/subjectId/117106093>
2. http://nptel.iitk.ac.in/courses/Webcoursecontents/IITKANPUR/HighSpeed_SemiconductorDevices/ui/Course_home-32.html
3. <https://www.youtube.com/watch?v=NVVlBq9RZec&list=PL804EBBC9541F0D5A>

4. <https://www.youtube.com/watch?v=wb2WY0CSciw&list=PL804EBBC9541F0D5A&index=2>

Web References:

1. <http://nptel.iitm.ac.in/courses/Webcoursecontents/IITDelhi/Semiconductor%20Devices/index.html>
2. https://www.academia.edu/2746256/Highspeed_electronics_and_optoelectronics_devices_and_circuits
3. http://cdn.teledynelecroy.com/files/appnotes/lecroy_dso_in_high_speed_electronics_appnote008.pdf

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4027	DIGITAL SPEECH PROCESSING							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Signals and Systems & Digital Signal Processing								
Course Objectives:								
<ol style="list-style-type: none"> 1. To understand the basic concepts of Speech processing and categories and location of speech sounds in Spectrograms. 2. To study Uniform tube modeling for speech production and speech perception methods for auditory system. 3. To analyze time domain methods for speech processing. 4. To Apply STFT for analysis and filtering of speech and Cepstral Transform for extraction of speech parameters. 5. To understand conversion of text to speech and speech recognition methods. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basic concepts of speech and audio processing.(BL-2)							
CO 2	Apply Uniform tube modelling for speech production and speech perception methods for auditory system.(BL-3)							
CO 3	Analyze time domain methods for speech processing.(BL-4)							
CO 4	Apply STFT for analysis and filtering of speech and Cepstral Transform for extraction of speech parameters.(BL-3)							
CO 5	Illustrate conversion of text to speech and speech recognition methods.(BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2										2	
CO2	3	2	1										1	2
CO3	3	3	2	1									1	1
CO4	3	2	2										2	2
CO5	3	2	2										2	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO SPEECH PROCESSING	9 Hrs
Introduction: Introduction to speech processing, Digitization and Recording of speech signal, Review of Digital Signal Processing Concepts.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Understand the basic concepts of Speech processing.(BL-2) 2. Explain need of Digitization and recording of speech signal.(BL-2) 3. Understand the production of speech from Human.(BL-2) 		
MODULE -2	ACOUSTIC PHONETICS	10 Hrs

Human Speech production, Acoustic Phonetics and Articulatory Phonetics, Different categories speech sounds and Location of sounds in the acoustic waveform and spectrograms.

At the end of the Module 2, students will be able to:

1. Explain Human speech production. (BL-2)
2. Understand Acoustic Phonetics. (BL-2)
3. Explain different categories of speech sounds (BL-2)

MODULE-3	TIME DOMAIN METHODS	8 Hrs
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Uniform Tube Modeling of Speech Production, Speech Perception, Time Domain Methods in Speech Processing, Analysis and Synthesis of Pole-Zero Speech Models

At the end of the Module 3, students will be able to:

1. Understand Uniform tube modeling. (BL-2)
2. Understand time domain methods for speech processing. (BL-2)
3. Analyze the analysis and synthesis of speech for Pole-Zero model. (BL-4)

MODULE-4	SHORT-TIME FOURIER TRANSFORM	10 Hrs
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Short-Time Fourier Transform, Analysis- FT view and Filtering view, Synthesis-Filter bank summation (FBS) Method and OLAMethod. Features of Extraction, Extraction of Fundamental frequency.

At the end of the Module 4, students will be able to:

1. Understand the Short-Time Fourier Transform method. (BL-2)
2. Apply STFT for analysis and filtering of speech. (BL-3)
3. Understand extraction of fundamental frequency for speech. (BL-2)

MODULE-5	SPEECH PROSODY	11 Hrs
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Speech Prosody, Speech Prosody Modeling -Fujisaki Model; Speech based Applications- TTS, ASR and spoken language acquisition.

At the end of the Module 5, students will be able to:

1. Understand conversion of text to speech. (BL-2)
2. Understand speech recognition methods. (BL-2)
3. Explain the concepts of speech based applications. (BL-2)

Total hours: 48 hours

Term work:

1. Literature Review & Tutorial questions.
2. Study speech recognition and submit the report on same.

Content beyond syllabus:

1. Spatial Audio Perception and rendering.
2. Audio quality analysis.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Digitization and recording	CO1	https://youtu.be/eUqqzPpmKSsw?list=PLvv3PyiCcNrFuT7CEIvIr4a4g4orascx3
2	Uniform tube modeling of speech	CO2	https://youtu.be/xo9XI-9CYa4?list=PLvv3PyiCcNrFuT7CEIvIr4a4g4orascx3
3	Analysis and synthesis of pole-zero speech models	CO3	https://youtu.be/aj0Ftip_Fug
4	Short-time fourier Transform	CO4	https://youtu.be/T9x2rvdhaIE
5	Automatic speech recognition	CO5	https://youtu.be/q67z7PTGRi8

Text Book(s):

1. Douglas O'Shaughnessy, Speech Communications: Human & Machine, IEEE Press, Hardcover 2/e, 1999; ISBN: 0780334493.
2. Nelson Morgan and Ben Gold, Speech and Audio Signal Processing: Processing and Perception Speech and Music, July 1999, John Wiley & Sons, ISBN: 0471351547

Reference Book(s):

1. Donald G. Childers, Speech Processing and Synthesis Toolboxes, John Wiley & Sons, September 1999; ISBN: 0471349593
2. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Prentice Hall; ISBN: 013242942X; 1/e
3. Rabiner and Juang, Fundamentals of Speech Recognition, Prentice Hall, 1994.

Online Resources:

1. <http://www.audiolabs-erlangen.de/fau/professor/habets/software/signal-generator>
2. <http://www.cse.ogi.edu/class/cse552/>

Web References:

1. <http://ocw.mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-345Automatic-Speech-RecognitionSpring2003/CourseHome/>
2. <http://www.icsi.berkeley.edu/ftp/global/pub/speech/papers/ieeespm95-hyb.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4028	FPGA Architectures							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Programmable logic devices, Combinational and Sequential logic circuit design								
Course Objectives: 1.To Understand the idea of programmable logic devices used in applications. 2.To Understand the Field Programmable Gate Array Architecture, Configurable Logic Block, Configurable I/O Block, Programmable Interconnection, Logic Optimization and Technology Mapping. 3. To acquire knowledge on various commercially available FPGA Architectures. 4.To Understand the Concepts of Placement and Routing in FPGAs. 5.To understand the SRAM and Antifuse Programming Technologies. 6.To Understand the FSM, Basic Concepts, Basic Properties, pertinent for Parallel Controllers.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the Programmable logic devices and different types of Complex programmable logic device family's architectures.(BL-2)							
CO 2	Interpret the FPGA Architecture, Logic synthesis, Logic Optimization and Technology Mapping..(BL-2)							
CO 3	Understand the Logic Block Architecture, placement and routing. .(BL-2)							
CO 4	Outline the various Xilinx and Actel FPGAs (BL-2)							
CO 5	Develop a simple Traffic Light controller, various adders and Decade Counter using FPGAs.(BL-3)							

CO-PO Mapping															
CO	PO												PSO		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		2										1	1	
CO2	3	1	1												
CO3	2	2	1												
CO4	3	2	2										1	1	
CO5	3	2	3										1	1	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-1	PROGRAMMABLE LOGIC DEVICES	10 hrs

ROM, PLA, PAL, PLD, – Features, Programming and Applications, Complex Programmable Logic Devices: Altera Series – Max 5000/7000 Series, Altera FLEX Logic – 10000 Series CPLD, AMD's – CPLD (Mach 1 To 5), Cypress FLASH 370 Device Technology, Lattice Plsi's Architectures – 3000 Series, Speed Performance and in System Programmability.

At the end of the Module 1, students will be able to:

- 1.Explain the basic structure of a programmable logic array (PLA).(BL2)
- 2.Differentiate between ROM,PAL,PLA,SPLD,CPLD,FPGA.(BL2)
- 3.Describe the architecture of the Altera MAX 7000 family of CPLDs.(BL2)
4. Illustrate the various Architectures of Complex Programmable Logic Devices Families.(BL2)

MODULE-2	FIELD PROGRAMMABLE GATE ARRAYS AND PROGRAMMING TECHNIQUES	10hrs
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Introduction to FPGAs, FPGA Design Flow, Configurable Logic Block, Programmable Interconnects, and Configurable I/O blocks in FPGAs, Logic Synthesis, Logic Optimization, and Technology Mapping for FPGA, The Chortle-crf Technology Mapper and the Chortle-d Technology Mapper.

Static RAM Programming Technology, Anti-fuse Programming Technology, EPROM and EEPROM Programming Technology, Summary of Programming Technologies

At the end of the Module 2, students will be able to:

- 1.Compare the features of Various FPGAs in terms of their Architecture, Configurable logic block and routing (BL2)
2. Demonstrate the basics of FPGA, FPGA Design Flow, and configurable logic block, programmable interconnects.(BL2)
- 3.Illustrate the Configurable Logic Block. (BL2)
4. Explain the different types programming technologies, programmable logic block architectures and their interconnects.(BL2)

MODULE-3	PLACEMENT & ROUTING FPGAs	9hours
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Introduction to Placement, Mincut-Based, Iterative Improvement and Simulated Annealing Placements, Introduction to Routing, Routing Terminology, General Strategy for Routing in FPGAs, Routing for Row-Based FPGAs , Introduction to Segmented Channel Routing and Maze Routing, Definitions for Segmented Channel Routing .

At the end of the Module 3, students will be able to:

1. Understand the concepts of Placement and routing in FPGAs.(BL2)
2. Explain the Segmented Channel Routing and Maze Routing.(BL2)
3. Compare the features of Various FPGAs in terms of their Architecture, Configurable logic block and routing.(BL2)

MODULE-4	Xilinx and Actel FPGA	10 hrs
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Introduction,Device Architecture:Simple SRAM Programmable FPGA Architecture, Design Trade-offs, Xilinx XC2000, XC3000 , XC4000 Architecturesand Programming the FPGA.

Introduction, Device Architecture: Principles of Programming Routing, Routing Architecture of the Actel FPGAs, ACT1, ACT2, ACT3 Architectures.

Commercially Available FPGAs: Xilinx, Actel, Altera, Plessey, Plus Logic, Advanced Micro Devices (AMD), Quick Logic and AlgoTronix.

At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain SRAM Programmable FPGAs.(BL2) 2. Understand the Xilinx Family FPGA.(BL2) 3. Explain the Routing architecture .(BL2) 4. Understand the ACTEL FPGA(BL2) 		
MODULE-5	FINITE STATE MACHINES	9hrs
Introduction to Finite State Machine, State Transition Table, and State Assignments for FPGAs, Problem of Initial State Assignment for One Hot Encoding, Hazard and One-Hot Encoding, State machines: Encoded and One Hot, Petri Nets for State Machines: Basic Concepts, Basic Properties, Extended Petri Nets for Parallel Controllers, Simple Example-A Traffic Light Controller. Design considerations using FPGAs of parallel adder cell, parallel adder, and sequential circuits-Decade Counter		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Design finite state machines for various applications.(BL3) 2. Describe One Hot Encoding and Pertinent for state machines.(BL2) 3. Understand the Basic Concepts and properties of State Machines.(BL2) 4. Develop parallel adder Cell, Parallel adder and Decade Counter.(BL3) 		
		Total hours: 48 hours

Term work: Design and Implementation of Traffic Lights Controller Using FPGA.

Content beyond syllabus: Salient features of Arrix 7 Series FPGA, and Basys development Board.

Self-Study:Contents to promote self-Learning

SN	Topic	Reference
1	Programmable Logic Devices	<ol style="list-style-type: none"> 1.https://www.youtube.com/watch?v=gCAYY0fHPq4 –PLA,PAL,PLD,CPLD and FPGA. https://www.youtube.com/watch?v=tJGtT9ky3H0 CPLD Architecture 2.https://www.youtube.com/watch?v=u35OKJOtVwQ&list=PLbMVogVj5nJSY-1XxFHgwtj2F7mB7NuV&index=34 --Simple PLDs, Complex PLDs
2	Field Programmable Gate Arrays	<ol style="list-style-type: none"> 1.https://www.youtube.com/watch?v=CLUoWkJUnN0-Introduction to FPGA https://www.youtube.com/watch?v=r8bziBVnPdU FPGA Architecture https://nptel.ac.in/courses/108/105/108105113/ - Configurable Logic Block https://www.youtube.com/watch?v=C3KCy4BQj34 Logic Synthesis https://www.youtube.com/watch?v=Y7fBOz9rAj0 https://www.youtube.com/watch?v=uwjEKf9NL2A

		-Technology Mapping
3	Commercially Available FPGAs	1. https://www.youtube.com/watch?v=e7iL2XulpI8- FPGA Overview 2. https://www.youtube.com/watch?v=OuO84HeLqDo -Altera and Actel FPGAS
4	Logic Block Architecture Placement and Routing FPGAS	1. https://www.youtube.com/watch?v=c2XkI5FB4U0 -Area-Efficient FPGA Logic Elements: Architecture and Sythesis 2. https://www.youtube.com/watch?v=XBH2smE0ZF8 (Placement, Routing, Simulated Annealing And Min-cut Algorithms)
5	FSM & Case Studies	1. https://www.youtube.com/watch?v=u3gM7YitptI&list=PLbMVogVj5nJSY-1XxFHgwgjt2F7mB7NuV&index=25 -FSM

Text Books:

1. S.Brown, R.Francis, J.Rose, Z.Vransic, "Field Programmable Gate Array", Kluwer Publications, 1992.
2. P.K.Chan& S. Mourad, "Digital Design Using Field Programmable Gate Array", prentice Hall (Pte), 1994.
3. J. Old Field, R.Dorf, "Field Programmable Gate Arrays", John Wiley & Sons, New York, 1995.

Reference Books:

1. S.Trimberger, Edr. "Field Programmable Gate Array Technology", Kluwer Academic Publications, 1994.
2. Bob Zeidman, "Designing with FPGAs & CPLDs", CMP Books, 2002.
3. Digital Systems Design - Charles H. Roth Jr, LizyKurian John, CengageLearning..
4. Digital Design Using Field Programmable Gate Arrays - Pak K. Chan/SamihaMourad, Pearson
5. FPGA based System Design - Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

Online Resources:

1. <https://www.youtube.com/watch?v=ht7nEjNydDU> -FPGA Introduction to FPGA
2. <https://www.youtube.com/watch?v=ahws--oNpBc> -An Introduction to FPGAs Architecture, Programmability and Advantages
3. <https://www.youtube.com/watch?v=hAl1894oPJM>(FPGA Based System)
4. <https://www.youtube.com/watch?v=njMFczRPg6I>(Introduction to FPGA)

Web References:

1. http://ece-research.unm.edu/jimp/415/contrib/toronto_fpga_tut.pdf -Architectures of FPGA & CPLD
2. http://ee.sharif.edu/~asic/Lectures/Lecture_06_FPGA.pdf FPGA Architectures
3. <https://courses.cs.washington.edu/courses/cse467/11wi/lectures/P&R%20guest%20lecture.pdf> - Placement and Routing
4. <https://www.ijeecse.com/9913-1.pdf> (Placement and Routing)

NARAYANA ENGINEERING COLLEGE:: GUDUR								
20EC4029	Embedded system design with ARM							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on Computer Organization, Digital Logic Design, Microprocessors & Microcontrollers.								
Course Objectives:								
1. To understand ARM microcontroller architecture								
2. To design D/A and A/D converters								
3. To demonstrate various sensing units								
4. To understand demonstrate ON feedback control system								
5. To explain internet of things								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Outline the concepts of embedded system (BL-2)							
CO 2	Explain sensors and actuators (BL-2)							
CO 3	Distinguish various sensing units (BL-4)							
CO 4	Understand object tracking using GPS and GSM(BL-2)							
CO 5	Outline basic concepts of Internet of things (BL-2)							

CO-PO Mapping														
CO	PO											PSO		
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3		3		2								2	2
CO2	3		3										2	2
CO3	3	2	2										2	2
CO4	3	2	3										2	2
CO5	3		3										2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO EMBEDDED SYSTEMS	9Hrs
Introduction to Embedded Systems and Microcontrollers, Instruction Set Architecture of ARM Microcontroller, and Assembly Language Programming.		
At the end of the Module 1, students will be able to:		
1. Outline the basic concepts of embedded systems (BL-2)		
2. Understand the architecture of ARM microcontroller(BL-2)		
3. Develop assembly language program (BL-3)		
MODULE -2	EMBEDDED FIRMWARE	12 Hrs

D/A and A/D converter, Sensors, Actuators and their Interfacing, Microcontroller Development Boards.

At the end of the Module 2, students will be able to:

1. Explain D/A and A/D converters (BL-2)
2. Understand actuators and their interfacing (BL-2)
3. Understand microcontroller development boards (BL-2)

MODULE-3	EMBEDDED PROGRAMMING	9 Hrs
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Embedded Programming platforms, Demonstration of Temperature sensing unit, Light sensing unit, Sound sensing unit.

At the end of the Module 3, students will be able to:

1. Explain embedded programming platforms (BL-2)
2. Understand various sensing units. (BL-2)

MODULE-4	EMBEDDED SYSTEM AND APPLICATION DEVELOPMENT	11 Hrs
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Demonstration ON Feedback control system, Relay control unit, driving electrical appliances like motors, bulb, pump, etc, Object tracking using GPS and GSM.

At the end of the Module 4, students will be able to:

1. Understand demonstration ON feed back control system (BL-2)
2. Explain relay control unit (BL-2)
3. Understand object tracking using GPS and GSM (BL-2)

MODULE-5	EMBEDDED SYSTEM AND APPLICATION DEVELOPMENT	7 Hrs
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Demonstration ON Introduction to Internet of Things, Smart home concepts, Motion sensing using accelerometer, control of appliances over SMS.

At the end of the Module 5, students will be able to:

1. Retrieve Demonstration ON (BL-1)
2. Outline internet of things (BL-2)
3. Develop control of appliances over SMS (BL-3)

Total hours: 48 hours

Term work:

1.

Content beyond syllabus:

Embedded firmware

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Introduction to Embedded systems	CO1	https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2	Sensors, actuators and their interfacing	CO2	https://www.fierceelectronics.com/embedded/sensors-actuators-and-their-interfaces
3	Temperature and light sensing units	CO3	https://onlinecourses.nptel.ac.in/noc22_cs93/preview
4	Embedded system and application development	CO4	https://bmsit.ac.in/public/assets/pdf/ece/studymaterial/17C62%20-%20Suryakanth%20B.M.pdf
5	Internet of things	CO5	https://en.wikipedia.org/wiki/Internet_of_things

Text Book(s):

1. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
2. Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003
3. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008.

Reference Book(s):

1. Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware / Software Introduction, John Wiley, 2002.
2. Jonathan W. Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, 3rd Edition Cengage Learning, 2012.
3. Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003.

Online Resources:

1. <https://www.youtube.com/watch?v=5SV9WFphahA>
2. <https://www.youtube.com/watch?v=GqPIuFM8KSU>
3. <https://www.youtube.com/watch?v=nRew-Lc7wnY>
4. <https://www.youtube.com/watch?v=arv68gb6PIA>

Web References:

1. http://demo.bharathuniv.ac.in/page_images/pdf/courseware_eee/Notes/NE2/BEE%20027%20Microcontroller%20based%20system%20design.pdf
2. <https://www.pdfdrive.com/sensors-actuators-and-their-interfaces-a-multidisciplinary-introduction-e186686340.html>
3. <https://www.oreilly.com/library/view/programming-embedded-systems/0596009836/ch01.html>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC4030	PROCESS CONTROL AND INSTRUMENTATION							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100
Pre-requisite: Differential Equations and Transforms								
Course Objectives:								
<ol style="list-style-type: none"> To study the characteristics of various process characteristics To understand the functions of process Control elements To study the Characteristics of PID controller, Auto manual transfer and tuning methods. To study the various control schemes. To understand the Multivariable Control 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Explain the fundamentals of process control systems.(BL-2)							
CO 2	Classify the final control elements. (BL-2)							
CO 3	Illustrate types of controllers and their characteristics.(BL-2) Explain the principles of controller tuning.(BL-2)							
CO 4	Explain the control strategies in process industries.(BL-2)							
CO5	Analyse the concepts of multiple control loops in industries.(BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2					2					2	2	
CO2	2	1	1										1	
CO3	2	1	2									2	1	
CO4	2	1	2										1	
CO5	2											2	2	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-1	PROCESS CHARACTERISTICS	9h
<p>Terms and Objectives, Incentives for process Control – design aspects of a Process Control System- Classification of variables. Process Equation, Process variables, Degrees of freedom. Characteristics of liquid system, gas system, thermal system. Mathematical modelling of processes. Self regulating-Servo and Regulatory, Interacting and Non-Interacting process.(9h)</p> <p>At the end of the Module 1, students will be able to:</p> <ul style="list-style-type: none"> Define the terms of process control. (BL-1) Explain different industrial processes like level, flow temperature systems mathematically. (BL-2) Explain servo and regulatory systems. (BL-2) 		
MODULE -2	PROCESS CONTROL ELEMENTS	9h
<p>Signal conversion - I/P, P/I Converters, Pneumatic and Electric actuators, Valve Positioner-Control Valve – Characteristics of Control Valves-Types of control valves-control valve sizing-cavitation and flashing. Dynamics of batch and Continuous process.(9h)</p>		

At the end of the Module 2, students will be able to:		
<ul style="list-style-type: none"> ▪ Define the concepts of Signal conversion. (BL-1) ▪ Classify actuating devices and their operation. (BL-2) ▪ Explain the control valve characteristics. (BL-2) 		
MODULE-3	CONTROLLER	12h
Basic control actions – Discontinuous control mode, Continuous control mode- Proportional, Single speed floating, Integral and Derivative– Composite control modes – P+I, P+D and P+I+D control modes.(6h)		
Response of controller for different types of test inputs –Integral windup – Auto manual transfer. Selection of control mode for different processes – Typical control schemes for level flow, pressure and temperature.		
Controller Tuning: – Zeigler and Nichols open and Closed loop methods, Performance indices– Based on evaluation criteria – ISE, IAE, ITAE.(6h)		
At the end of the Module 3, students will be able to:		
<ul style="list-style-type: none"> ▪ Summarize controller modes. (BL-2) ▪ Classify the controller modes. (BL-2) ▪ Compare the characteristics controllers. (BL-2) ▪ Define the testing of control system. (BL-1) ▪ Demonstrate control schemes for level, flow, pressure and temperature systems. (BL-2) ▪ Explain the tuning mechanisms of controller. (BL-2) 		
MODULE-4	VARIOUS CONTROL SCHEMES	8h
Feed Forward Control ,Cascade control , Ratio control, Over ride control, Split range control , Selective control ,Adaptive control, Inferential control.(8h)		
At the end of the Module 5, students will be able to:		
<ul style="list-style-type: none"> ▪ Classify the control strategies in process industry. (BL-2) ▪ Explain the characteristics of control strategies. (BL-2) ▪ List the applications of these strategies. (BL-2) 		
MODULE-5	MULTIVARIABLE CONTROL	10h
Introduction -Control loop interaction –motivation – general pairing problem- relative gain array-properties- application of RGA- RGA sensitivity zeros and performance limitation – scaling consideration-block diagram analysis- decoupling design of non interacting control loops Piping and Instrumentation Diagram, Instrument terms and Symbols. Introduction to Intelligent controllers.(10h)		
At the end of the Module 5, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain loop interaction. (BL-2) ▪ Analyse the impact of interaction. (BL-4) ▪ Explain the mathematical concepts of RGA. (BL-2) 		
At the end of the Module 5, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain loop interaction. (BL-2) ▪ Analyse the impact of interaction. (BL-4) ▪ Explain the mathematical concepts of RGA. (BL-2) 		
		Total hours:48 hours

Term work:

1.List out Process control oriented industries as on today in india. Submit the report on each industry with following details:

Control room ,Boiler systems, Types of Valves , piping and instrumentation diagrams, Safety measures .

2. .List out Process control oriented industries as on today in Germany. Submit the report on each industry with following details:

Control room ,Boiler systems, Types of Valves , piping and instrumentation diagrams, Safety measures .

Content beyond syllabus:		
1. Model predictive control 2. Heuristics-based controller tuning		
Self-Study:		
Contents to promote self-Learning:		
SNO	Topic	Reference
1	Mathematical modeling	https://www.slideshare.net/meenasundar/class-7-mathematical-modeling-of-liquidlevel-systems
2	Control valves	https://www.slideshare.net/meenasundar/class-42-control-valves-valve-positioners-cavitation-and-flashing?next_slideshow=1
3	Control Modes, Controller tuning	https://www.slideshare.net/meenasundar/class-19-pi-pd-control-modes
		https://www.slideshare.net/meenasundar/class-30-controller-tuning?qid=ff6a98f3-e881-4ff2-88b4-8a153deaaa1d&v=&b=&from_search=40
4	Control strategies	https://nptel.ac.in/courses/108/105/108105088/
5	Control loop interaction	https://nptel.ac.in/content/storage2/courses/103101003/downloads/lecture-notes/APC_Part_5_Interaction%20Analysis%20and%20Multiloop%20Control.pdf

Text Book(s):

1. C.Stefanopoulos, —Chemical process control, Prentice Hall of India. 1998.
2. Singh, Process Control PHI Learning, 2009 Format
3. Curtis D Johnson, Process Control Instrumentation Technology TMH.

Reference Book(s):

1. D.P. Eckman, —Automatic Process Control, Wiley Eastern Ltd., 1972.
2. D.R. Coughanowr, —Process System Analysis and Control, Second Edition, McGraw Hill 1991.
3. K. Ogata, —Modern Control Engineering, Prentice Hall of India, 1982.

Online Resources:

1. <https://www.slideshare.net/search/slideshow?searchfrom=header&q=ice401>
2. <https://nptel.ac.in/courses/103/103/103103037/>
3. <https://nptel.ac.in/courses/108/105/108105062/>

Web References:

1. https://www.academia.edu/37141836/Chemical_Process_Control_An_Introduction_to_Theory_and_Practice_-_George_Stephanopoulos
2. <https://nptel.ac.in/courses/103/105/103105064>
3. <https://archive.nptel.ac.in/courses/103/105/103105064>
4. https://onlinecourses.nptel.ac.in/noc21_ch38/preview
5. https://onlinecourses.nptel.ac.in/noc21_ch04/preview

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3001	IMAGE PROCESSING							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisites: Basics of signals and images.								
Course Objectives:								
<ul style="list-style-type: none"> To understand the image fundamentals and basic operation involved in image processing. To outline various images transforms. To illustrate the concepts of image enhancement in spatial and frequency domain. To understand the concepts of image restoration and segmentation To acquire knowledge on image compression methods. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the image processing fundamentals and basic relationship between pixels.(BL-02)							
CO 2	Compare the working principles of various image transforms. (BL-03)							
CO 3	Illustrate the concepts of image enhancement in spatial and frequency domain .(BL-02)							
CO 4	Analyze the image restoration techniques and concepts of segmentation(BL-03)							
CO 5	Categorize different image compression methods.(BL-04)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												1	
CO2	2	3	1		1								2	
CO3	2	1	2		1								2	
CO4	2	1	2		1								2	1
CO5	2	1	2		1								1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO IMAGE PROCESSING	09 Hrs
Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and acquisition, image sampling and quantization, Arithmetic and logical operations, image geometry.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Understand the fundamentals of image processing. (BL-02) Explain the formation of digital image. (BL-02) Explain the concept of image sampling and quantization. (BL-02) 		
MODULE -2	IMAGE TRANSFORMS	10 Hrs

IMAGE TRANSFORMS: Introduction, 2-D DFT, properties, Walsh transform, Hadamard transform, discrete cosine transform, Haar transform, comparison of different transforms.

1. Understand the basic concepts of image transforms. (BL-02)
2. Explain efficient image transform for conversion. (BL-02)
3. Compare various image transforms. (BL-02)

MODULE -3	IMAGE ENHANCEMENT	9 Hrs
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IMAGE ENHANCEMENT: Gray level transformations, Histogram processing, image smoothing and sharpening filters in spatial domain (by spatial domain methods), Image smoothing and image sharpening filters in frequency domain, homomorphic filtering.

At the end of the Module 2, students will be able to:

1. Explain gray level transformation technique. (BL-02)
2. Explain various image enhancement techniques. (BL-02)
3. Illustrate the concept of homomorphic filter. (BL-02)

MODULE-4	IMAGE RESTORATION & SEGMENTATION	10 Hrs
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IMAGE RESTORATION & SEGMENTATION: Image degradation/Restoration model, Noise models, Restoration in the presence of Noise only-spatial filtering - mean, order statistic and adaptive filters. Estimating the degradation function, Inverse filtering, Weiner filters. Detection of discontinuities- Point, line and edge Detection, Thresholding- global thresholding, adaptive thresholding, Region based Segmentation.

At the end of the Module 4, students will be able to:

1. Explain Image restoration using filtering Techniques. (BL-02)
2. Compare the different noise models. (BL-02)
3. Select the proper filtering technique for image restoration. (BL-01)
4. Explain the thresholding techniques for image segmentation. (BL-02)

MODULE-5	IMAGE COMPRESSION	10 Hrs
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IMAGE COMPRESSION: Types of redundancy, lossless compression: Huffman coding, Arithmetic coding, Variable length coding, bit plane coding, predictive coding- DPCM. Lossy compression: Transform coding, basics of image compression standards: JPEG, JPEG 2000

At the end of the Module , students will be able to:

1. Explain the various image compression techniques. (BL-02)
2. Explain Lossy image compression model. (BL-02)
3. Understand image compression standards. (BL-02)
4. Compare lossy and loss less compression models. (BL-02)

Total hours:	48 hours
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Content beyond syllabus:

Morphological Processing: Erosion, Dilation, Opening, Closing, White Tophat, Black Tophat, Skeletonize, Convex Hull.

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Fundamentals of digital image processing	https://medium.com/futframe-ai/fundamental-steps-of-digital-image-processing-d7518d6bb23c https://www.geeksforgeeks.org/digital-image-processing-basics/ https://www.youtube.com/watch?v=1FhypxIo42c

2	Image transforms	https://www.slideshare.net/pareshkamble/image-transforms https://www.google.com/search?ie=utf-8&oe=utf-8&cs0=1&q=Image+transforms https://www.youtube.com/watch?v=YvTVI0dboiM&list=PLL6Ah8JHS-GBuEyZyPzXW6wY-b6WATRI3&index=1
3	Image Enhancement	https://www.slideshare.net/abhiabhinay/image-enhancement-techniques-24165028 https://www.youtube.com/watch?v=UbDeuBQyKBA
4	Image Restoration & Segmentation	https://www.abtosoftware.com/blog/image-restoration http://fourier.eng.hmc.edu/e101/lectures/Image_Processing/node9.html (Inverse filtering) https://nptel.ac.in/content/storage2/courses/117104069/chapter_9/9_18.html (Inverse filtering) https://nptel.ac.in/content/storage2/courses/112101098/download/lecture-30.pdf (Image Segmentation)
5	Image Compression	https://nptel.ac.in/content/storage2/courses/117105083/pdf/ssg_m6117.pdf https://www.youtube.com/watch?v=azOTpEYMsQQ

Text Book(s):

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, fourth Edition, Pearson Education Global edition 2018
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India. 2nd edition 2004
3. S. Shridhar, Digital Image Processing, Oxford University Press.

Reference Book(s):

1. Rafael C. Gonzalez, Richard E woods and Steven L. Eddins, Digital Image processing using MATLAB”, Tata McGraw Hill, 2010.
2. S jayaraman, S Esakkirajan, T Veerakumar, Digital Image processing”, Tata McGraw Hill
3. William K. Pratt, “Digital Image Processing, John Wiley, 3rd Edition, 2004.

Online Resources/ Web References:

1. <https://nptel.ac.in/courses/117/105/117105079/>
2. <https://nptel.ac.in/courses/117/105/117105135/>
3. <https://nptel.ac.in/courses/106/105/106105032/>
4. https://www.tutorialspoint.com/dip/image_processing_introduction.htm
5. <https://www.tutorialspoint.com/dip/index.htm#:~:text=DIP%20focuses%20on%20developing%20a,common%20example%20is%20Adobe%20Photoshop.>
6. <http://jainpoojith.blogspot.com/2009/03/tutorial-5digital-image-processingimage.html>
7. <https://dl.ebooksworld.ir/motoman/Digital.Image.Processing.4th.Edition.www.EBooksWorld.ir.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3002	EMBEDDED SYSTEMS							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on Computer Organization, Digital Logic Design, Microprocessors & Microcontrollers.								
Course Objectives:								
<ul style="list-style-type: none"> To understand the technology behind the embedded computing systems. To outline the design issues of embedded systems. To develop software programs for embedded systems. To understand the internal architecture, addressing modes & instruction set of MSP430. To understand the concepts of real time operating system and multitasking. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basic structure and design of an Embedded System. (BL-02)							
CO 2	Illustrate the different hardware modules and design approaches of embedded firmware. (BL-02)							
CO 3	Analyze the internal architecture, addressing modes & instruction set of MSP430. (BL-04)							
CO 4	Develop embedded programs for various applications. (BL-03)							
CO 5	Interpret the concepts of real time operating system and multitasking. (BL-02)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2												2	
CO2	2	1	2		2								2	1
CO3	2		2		2								2	1
CO4	2		2	1	2								1	2
CO5	2	1	2	1	2								1	2
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Introduction to Embedded Systems	10 Hrs
Definition of Embedded Systems, History of Embedded Systems, Classification, major application areas, characteristics and quality attributes of Embedded Systems. Anatomy of Embedded Processor, memory, software.		
At the end of the Module 1, students will be able to :		
<ol style="list-style-type: none"> Outline the basic concepts and history of embedded systems. (BL-02) List the various application areas of embedded systems. (BL-01) Explain the quality attributes of embedded systems. (BL-02) Understand the memory and software concepts of embedded processor. (BL-02) 		
MODULE -2	Embedded Firmware	10Hrs
Reset Circuit, Brown-out protection circuit, Oscillator Unit, Real Time Clock, Watch dog Timer, Embedded Firmware Design Approaches and Development Languages.		
ROM, RAM, Memory selection for Embedded System, Sensors and Actuators, Onboard and External Communication Interface.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> List the various embedded hardware modules.(BL-01) Explain embedded firmware design approaches.(BL-02) Understand the interfacing of onboard and external communication.(BL-02) 		
MODULE-3	Architecture of MSP 430	08 Hrs
Introduction, Functional Block Diagram, Pin out, CPU, Memory, Memory mapped I/O, Clock Generator, Interrupts, Resets, Addressing modes, Instruction set.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> Understand the internal architecture of MSP430 microcontroller. (BL-2) Explain memory organization of MSP430 microcontroller. (BL-2) Explain various addressing modes to represent data in an instruction. (BL-2) 		
MODULE-4	Embedded Programming	10Hrs
Development Environment – C Language, Assembly Language. Programming, Sample programs – Light LEDs, Read input from a switch, Flashing light by delay, Automatic control, use of Subroutines, Timers, Interrupts, Functions, Header files and low power modes.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> Understand the programming concepts of C language.(BL-02) Develop embedded programs for various applications.(BL-03) Explain the use of subroutines, timers and interrupts. (BL-02) 		
MODULE-5	RTOS Based Embedded System Design	10 Hrs
Introduction, Operating System basics, Types of Operating Systems, Task, Process & Threads. Interrupt routines in RTOS, Multiprocessing and Multitasking, Scheduling, Task Communication, message passing, Task synchronization techniques and issues.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> Understand the basic concepts of operating systems. (BL-02) Explain multiprocessing and multitasking. (BL-02) Explain interrupt routines in RTOS. (BL-02) List the various issues of task synchronization techniques.(BL-01) 		
Total hours:		48 hours

Content beyond syllabus:

- Recent trends of Development in embedded system.
- Application in biomedical field.
- Skills required for an embedded designer.
- Simulation of Embedded C Programs for practical exposure.

Self-Study:

Contents to promote self-Learning:

SN	Module	Reference
1	Introduction to embedded systems	https://www.elprocus.com/basics-of-embedded-system-and-applications/ https://www.oreilly.com/library/view/programming-embedded-systems/0596009836/ch01.html https://www.youtube.com/watch?v=uFhDGagZzjs
2	Embedded Firmware	https://www.maxfizz.com/components-of-embedded-system/

		https://www.youtube.com/watch?v=Vlyg1URzaro
3	Architecture of MSP430	https://www.globalspec.com/reference/81955/203279/chapter-5-architecture-of-the-msp430-processor https://www.youtube.com/watch?v=8hFQB5YlvPE
4	Embedded Programming	https://www.electronicshub.org/basics-of-embedded-c-program/ https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/ https://robosumo.wordpress.com/2014/02/07/fast-slow-blinking-led-example-for-msp430-and-switch/
5	RTOS Based Embedded System Design	https://www.engineersgarage.com/article_page/rtos-real-time-operating-system/ https://www.geeksforgeeks.org/difference-between-multitasking-multithreading-and-multiprocessing/ https://www.youtube.com/watch?v=Bue0ozYd7DM

Text Book(s):

1. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008.
3. Rajkamal, Embedded Systems Architecture, Programming and Design, TMH, 2003

Reference Book(s):

1. Frank Vahid and Tony Givargis, Embedded Systems Design – A Unified Hardware / Software Introduction, John Wiley, 2002.
2. Iyer - Embedded Real time Systems, 1e, McGraw Hill Education New Delhi, 2003.
3. K.V. Shibu, Introduction to Embedded Systems, 2e, McGraw Hill Education India, 2016.
4. Lyla B. Das, Embedded Systems: An Integrated Approach, 1/e , Lyla B. Das, Embedded Systems, 2012.
5. Steve Heath, Embedded Systems Design, Newnes – Elsevier 2ed, 2002
6. Tammy Noergaard, Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Newnes – Elsevier 2ed, 2012.

Online Resources/Web References:

1. <https://www.youtube.com/watch?v=uFhDGagZzjs>
2. <https://www.youtube.com/watch?v=Vlyg1URzaro>
3. <https://training.ti.com/msp430-ultra-low-power-microcontroller-overview>
4. <http://www.ocfreaks.com/msp430-gpio-programming-tutorial/>
5. <https://www.youtube.com/watch?v=-zqqZqOafEs>
6. http://www.brainkart.com/subject/Embedded-and-Real-Time-Systems_186/
7. http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/
8. <https://www.techopedia.com/definition/2273/real-time-clock-rtc>
9. [https://siet.secab.org/Attendance/admin/resource/306_15EC62_module-3%20\(Autosaved\)%20ARM%20...pdf](https://siet.secab.org/Attendance/admin/resource/306_15EC62_module-3%20(Autosaved)%20ARM%20...pdf)
10. <http://eleceng.dit.ie/frank/msp430/msp430.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3003	NANO TECHNOLOGY							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Courses on Basic Engineering Physics, Basic Engineering Chemistry and Electronic Devices.								
Course Objectives:								
<ul style="list-style-type: none"> To understand the basic scientific concepts of nanoscience. To illustrate the properties of nano materials. To understand synthesis and fabrication of nano structures. To illustrate the various characterization techniques of nano materials. To summarize the applications of nano technology in various science, engineering and technology fields. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the history of nano science and technology.(BL-02)							
CO 2	Outline different properties and structure of nanomaterials.(BL-02)							
CO 3	Illustrate bottom-up and top-down approach in synthesis & fabrication. (BL-02)							
CO 4	Analyze different microscopy & spectroscopy techniques.(BL-03)							
CO 5	Apply the carbon Nano technology for real time applications.(BL-03)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	3												1	
CO3	2	2	2		1								1	
CO4	3	1	1		1								1	
CO5	2	1	2		1								2	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	Introduction to Nano Technology	09 Hrs
History of nano science, definition of nano meter, nano materials, nano technology, Classification of nano materials, Crystal symmetries, crystal directions, crystal planes. Band structure.		
At the end of the Module 1, students will be able to :		
<ol style="list-style-type: none"> Explain the history of nano science and nano technology.(BL-02) Classify nano materials.(BL-02) Understand the concepts of crystal symmetries, crystal directions & crystal planes. (BL-02) 		
MODULE -2	PROPERTIES OF NANO MATERIALS	09 Hrs
Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Understand the mechanical and electrical properties of nano materials. (BL-02) Explain the magnetic and dielectric properties of nano materials. (BL-02) Explain the structure of nano materials. (BL-02) 		
MODULE-3	SYNTHESIS AND FABRICATION	10 Hrs

Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom Up Approach – sol gel synthesis, CVD; Top Down Approach – Ball milling, lithography. Requirements for realizing semiconductor nano structures,.

At the end of the Module 3, students will be able to:

1. Outline the steps involved in synthesis of nano particles. **(BL-02)**
2. Explain bottom-up and top-down approach in synthesis & fabrication. **(BL-02)**
3. Understand growth techniques for nano structures. **(BL-02)**

MODULE-4	CHARACTERIZATION TECHNIQUES	10 Hrs
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X-Ray diffraction, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, XANES and XAFS, angle resolved photoemission spectroscopy, photoluminescence spectra, Raman spectroscopy.

At the end of the Module 4, students will be able to:

1. Explain X-Ray diffraction and Scherrer method. **(BL-02)**
2. Understand different microscopy techniques. **(BL-02)**
3. Illustrate different spectroscopy techniques. **(BL-02)**

MODULE-5	CARBON NANO TECHNOLOGY & APPLICATIONS	10 Hrs
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Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalline diamond films, graphene, applications of carbon nano tubes. Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin films, applications of quantum dots.

At the end of the Module 5, students will be able to:

1. Understand the characterization of carbon allotropes. **(BL-02)**
2. Explain the synthesis and nucleation of diamond. **(BL-02)**
3. List the applications of carbon nano tubes. **(BL-01)**
4. List the applications of nano technology in material science, biology and medicine. **(BL-01)**
5. Explain the applications of nano structured thin films. **(BL-02)**

Total hours: 48 hours

Content beyond syllabus:

1. Advanced nano materials
2. Nanoscale magnetic materials and Devices

Self-Study:

Contents to promote self-Learning:

SN	Module	Reference
1	Introduction to Nano Technology	https://www.understandingnano.com/introduction.html https://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_2.php https://www.youtube.com/watch?v=k61wjab7iUs
2	Properties of Nano Materials	https://www.slideshare.net/ParthaPMishra/properties-of-nanomaterials https://www.youtube.com/watch?v=RvtlBh_-Rw
3	Synthesis and Fabrication	https://www.slideshare.net/RamalingamGopal/sol-gel-synthesis-of-nanoparticles (sol gel synthesis)

		https://www.understandingnano.com/nanomaterial-synthesis-ball-milling.html (ball milling method) https://www.youtube.com/watch?v=Vjxo9-GeIdc https://www.youtube.com/watch?v=cQgnjRnU35k
4	Characterization Techniques	https://www.nanoscience.com/techniques/scanning-electron-microscopy/ (scanning electron microscopy) https://parksystems.com/medias/nano-academy/how-afm-works (atomic force microscopy) https://arpes.stanford.edu/research/tool-development/angle-resolved-photoemission-spectroscopy (angle resolved photoemission spectroscopy)
5	Carbon Nano Technology & Applications	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5848992/ (characterization of carbon allotropes) https://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_22.php https://www.slideshare.net/nkp8490/applications-of-carbon-nanotubes (applications of carbon nano tubes) https://www.nanotechetc.com/6-of-the-best-applications-of-nanotechnology-in-biology-and-medicine/ (biology and medicine) https://www.cd-bioparticles.com/t/Properties-and-Applications-of-Quantum-Dots_56.html (applications of quantum dots)

Text Book(s):

1. Nano science and nano technology by M.S Ramachandra Rao, Shubra Singh, Wiley publishers.
2. Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
3. Nano Essentials- T.Pradeep/TMH.

Reference Book(s):

- 1.Nanotechnology by Jermy J Ramsden, Elsevier publishers.
- 2.Nano Materials- A.K.Bandyopadhyay/ New Age Introdu.
- 3.Nanotechnology the Science of Small by M.A Shah, K.A Shah, Wiley Publishers.
- 4.Principles of Nanotechnology by Phani Kumar, Scitech.

Online Resources/ Web References:

1. <https://nptel.ac.in/courses/118/104/118104008/>(IIT Kanpur)
2. <https://nptel.ac.in/courses/113/106/113106093/>(IIT Madras)
3. <https://nptel.ac.in/courses/118/107/118107015/> (IIT Roorkee)
4. <https://www.youtube.com/watch?v=k61wjab7iUs> (Introduction to Nano)
5. <https://www.youtube.com/watch?v=-xUGNeJg8nE>(Properties of nano materials)
6. <http://www.tjprc.org/publishpapers/--1380785197-9.%20Applications%20and%20characteristics.full.pdf>
7. <http://nopr.niscair.res.in/bitstream/123456789/2019/1/IJFTR%2033%283%29%20304-317.pdf>
8. https://www.ijesm.co.in/uploads/68/4481_pdf.pdf
9. <https://www.longdom.org/open-access/applications-of-nanotechnology-2155-983X-1000131.pdf>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3004	VLSI DESIGN							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
	3	0	0	48	3	40	60	100
Pre-requisite: Basics of semiconductor devices, Electronics circuits, Digital logic Design, Physics.								
Course Objectives:								
1. To understand the fabrication process of MOS, CMOS, Bi-CMOS Transistors, the electrical properties of MOS circuits								
2.To Know the design rules, layout diagrams, stick diagrams and will also acquaint with knowledge on electrical constraint while designing								
3. To know the design of various complex logic gates using CMOS and other forms of logic.								
4.Subsystem design is used in VLSI integrated circuits for adders, multipliers, shifters, ALUs and Array Subsystems used in sequential circuit designs i.e. SRAM, DRAM.								
5 To know the architectural details of FPGAs, CPLDs and procedural steps to develop semiconductor ICs like Full-Custom, Semi-Custom & programmable ICs.								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Analyze the MOS Device Equations & CMOS basic inverter characteristics. (BL-4).							
CO 2	Apply the concepts of stick diagrams and layout design rules for CMOS Circuits. (BL-3).							
CO 3	Design the digital complex logic gate design of various types using CMOS and other forms of logic. (BL-6).							
CO 4	Develop various Data Path subsystems, parity generators, and array of memories to compensate trade-off area, speed and power requirements. (BL-6).							
CO 5	Demonstrate the semiconductor IC design such as PLAs, FPGAs and CPLDs. (BL-3).							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2		1								2	
CO 2	3	1	2		2								2	1
CO 3	3	1	2	1	2								2	1
CO 4	3	1	3	1	2								2	2
CO5	3	1	3	2	2								2	3
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE-1	Introduction to MOS Technologies	12 hours
Introduction to integrated circuit technologies, Basic of MOS transistors, enhancement mode MOS transistor, depletion mode MOS transistor, NMOS and CMOS fabrication, BICMOS.		
ELECTRICAL PROPERTIES : I_{ds} - V_{ds} relationships, Threshold Voltage, Body effect, Channel length modulation, gm, gds, figure of merit ω_0 , Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Latch-up in CMOS circuits		

At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate the evolution of Integrated Circuits and MOS Technologies. (BL-2). 2. Compare Bipolar, NMOS, CMOS, BICMOS and GaAs technologies. (BL-2). 3. Explain PMOS Fabrication Process. (BL-2). 4. Interpret the fundamentals of MOS devices and its V-I characteristics.(BL- 4) 5. Compare the relative merits of the three different forms of pull-up for an inverter circuit.(BL-2). 		
MODULE-2	VLSI CIRCUIT DESIGN PROCESS	9 hours
VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μ m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS, CMOS Inverters and Gates, Scaling of MOS Circuits: Scaling models, Scaling factors for device parameters, Limitations of Scaling.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Develop the Layout of simple MOS circuits using Lambda based design rules. (BL-3). 2. Demonstrate how the NMOS, CMOS transistors layouts are built using 2μm CMOS Design rules. 3. Illustrate the scaling models and scaling factors for NMOS,PMOS and CMOS Devices.(BL-2) 4. Infer the limitations of scaling. 		
MODULE-3	GATE LEVEL DESIGN	9 hours
Logic gates and other complex gates, Switch logic, Other Forms of CMOS Logic: Pseudo-nMOS logic, Dynamic CMOS logic, Clocked CMOS (C ² MOS) logic, CMOS Domino Logic, n-p CMOS logic.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Demonstrate any logic function into Gate level design. (BL-2) 2. Illustrate various logic circuits with different design styles. (BL-2) 3. Explain CMOS domino logic and give its advantages and disadvantages. (BL-2) 4. Compare the other forms of CMOS Logic. (BL-2) 		
MODULE-4	DATA PATH SUBSYSTEMS	9 hours
Shifters, Design of an ALU Subsystem, Adders, Multipliers, Parity generators, SRAM, DRAM, ROM, Serial Access Memories, and Content Addressable Memory.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Interpret the different architectures for adders.(BL-2) 2. Identify the speed and area trade off Adders, Multipliers and shifters.(BL-3) 3. Demonstrate the working principle and operation of different Memories. (BL-2). 4. Illustrate the read and write operations in static RAM with neat diagram. (BL-2) 		
MODULE-5	IMPLEMENTATION STRATEGIES	9hours
Full custom, Standard Cell, Gate Array based ASICs, PLA, PAL, PLD, and CPLD & FPGA Architecture. Programmable Array Logic, Design Approach.		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Illustrate the techniques of chip design using programmable devices. (BL-2). 2. Demonstrate the architecture and routing procedures of CPLD & FPGA. (BL-2). 		
Total hours:		48 hours

Content beyond syllabus:

Physical Design: Floor-Planning, Placement and Routing.

Self-Study: Contents to promote self-Learning:

SNO	Module	Reference
1	Introduction to MOS Technologies & Fab Basic Electrical Properties of MOS & Bi-CMOS Circuits.	https://www.youtube.com/watch?v=lpXNCwsnxjM (Integrated Circuit Technology) https://www.youtube.com/watch?v=kcJi8gJ1kBo (History-Future Trends) https://www.youtube.com/watch?v=WsdVCCJsyfU (Evolution Integrated Circuits) https://www.youtube.com/watch?v=9SnR3M3CIm4&t=243s (Introduction to VLSI Design Basics) https://www.youtube.com/watch?v=WBa2Fw5-yU4 (MOS Transistor Switches and CMOS Logic) https://www.youtube.com/watch?v=p4E1to95w_w&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=13&t=0s (Enhancement mode MOSFET Operation) https://www.youtube.com/watch?v=b6QRdt0xZwA&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=13 (Depletion mode MOSFET Operation) https://www.youtube.com/watch?v=ptLeMiTgwJA (NMOS Fabrication Process). https://www.youtube.com/watch?v=QUExo3nSyxY (CMOS Fabrication) https://www.youtube.com/watch?v=b827fsVm7_4 (Fabrication of n-well Process) https://www.youtube.com/watch?v=2bdAYqZqudQ (Continuation of p-well) https://www.youtube.com/watch?v=Cld7ux8kQi8 (Twin Tub) https://www.youtube.com/watch?v=-4jOzGN0GTw (BiCMOS Fabrication Process) https://www.youtube.com/watch?v=y3cSgK-wmFs (SOI Process). https://www.youtube.com/watch?v=hHVbFHjccO8 (Resistors) https://www.youtube.com/watch?v=jp72NWXdkvA (Integrated resistor and Capacitor) https://www.youtube.com/watch?v=rpuddEum2k&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=2&t=0s (Basic Electrical Properties part-1) https://www.youtube.com/watch?v=C2mm4UbPIT0&list=

		<p>PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=3&t=0s (Part-2) https://www.youtube.com/watch?v=L7s9Ar0XdMw&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=4&t=0s (Part-3) https://www.youtube.com/watch?v=CpK-3w8zURI (nMOS Logic Circuits-Pull-ups) https://www.youtube.com/watch?v=fqiYu6IOtmU(CMOS Inverter Analysis) https://www.youtube.com/watch?v=57U1LxJD0kc&list=PLqilb1UO8M-XEyTzvmZZ_9t9ycpKOIG28&index=5&t=0s(BICMOS) https://www.youtube.com/watch?v=uihFUbOTIzM Latchup in CMOS Logic</p>	
2	VLSI Circuit design Processes	<p>https://www.youtube.com/watch?v=x68G7FUP9k4 https://www.youtube.com/watch?v=iRoazTYnJqo (Stick Diagrams) https://www.youtube.com/watch?v=Ew1ii_XYdtg&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=2&t=0s -1 https://www.youtube.com/watch?v=tT511b3qLWc&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=3&t=0s -2 https://www.youtube.com/watch?v=k4EnmTuIepE&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=4&t=0s -3 https://www.youtube.com/watch?v=GpVHcXoZkA0&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=5&t=0s -4 https://www.youtube.com/watch?v=jkofN9fhHK8&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=6&t=0s - 5 https://www.youtube.com/watch?v=SC4nDbebpsM&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=12&t=0s- (CMOS XOR Gate) https://www.youtube.com/watch?v=D_M_6xgyxjo&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=9&t=0s (Design Rules and layout for cmos logic gates) https://www.youtube.com/watch?v=1aqKlr0NsiU (MOS LAYERS,STICK Diagrams, Design Rules and Layout) https://www.youtube.com/watch?v=vXb3miSeXZw&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=9&t=0s</p>	

		gsYt2XrfniG&index=10&t=0s (Types of contact Cuts) https://www.youtube.com/playlist?list=PLqilb1UO8M-W65iA7Pr8E3_QyWHgnon1S (Basic Circuit Concepts)
3	Gate Level Design	https://www.youtube.com/watch?v=8caQpnxa3iE (CMOS NAND,NOR and Other Gates: Clocked CMOS) https://www.youtube.com/watch?v=q8adOpQx7tc (Dynamic CMOS,Pass transistor, Transmission gate)
4	Data Path Subsystems	https://www.youtube.com/playlist?list=PLqilb1UO8M-US31joQFPJ4juX1sX9KkcH (VLSI Subsystem Design) https://www.youtube.com/watch?v=36hCizOk4PA (Half & Full Adder, Carrylook ahead adder) https://www.youtube.com/watch?v=4ukbN83kY54&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=26&t=0s (Design of 4 Bit ALU) https://www.youtube.com/watch?v=Lc-AWOJ1qwo&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=27&t=0s (Carry select adder, carry skip adder, CLA) https://www.youtube.com/watch?v=EMcW9EggY0s&list=PLbMVogVj5nJTD6KqQXNexCvooSMnBuXj&index=13 (Multipliers) https://www.youtube.com/watch?v=5-PI4T25OXI&list=PLZe4P0P_9CovC7jP0URDHzi31kkTEMS70&index= (Array Multiplier) https://www.youtube.com/watch?v=5PVweRB4QvY&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG&index=24&t=0s (4 Bit Barrel Shifter) https://www.youtube.com/watch?v=HuSWjf0NTol (Parity generator) https://www.youtube.com/watch?v=dmBc-E3EpgA https://www.youtube.com/watch?v=k5VBJcUcaWU (High Density Memories) https://www.youtube.com/watch?v=wNNTz_My2ps (DRAM)
5	Semiconductor Integrated Circuit Design	https://www.youtube.com/watch?v=JAN7odb8n90 (Full Custom, semi Custom etc) https://www.youtube.com/watch?v=gCAYY0fHPq4 (PLDS:PLA,PAL,CPLD,FPGA)

			https://www.youtube.com/watch?v=khZkhE6wJis (Vlsi Design Methodology) https://www.youtube.com/watch?v=CLUoWkJUnN0&list=PLB19593440B2BB5DC&index=36&t=0s (Introduction to FPGA) https://www.youtube.com/watch?v=tJGtT9ky3H0 CPLD Architecture https://www.youtube.com/watch?v=kg5FAIAQdmU CPLD &FPGA https://www.youtube.com/watch?v=r8bziBVnPdU https://www.youtube.com/watch?v=0nMHJ0VoYhY FPGA Architecture https://www.youtube.com/watch?v=n0x1jhsZDUg&list=PLB19593	
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Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, *Essentials of VLSI Circuits and Systems*, PHI, 2005.
2. P.P. Sahu, *VLSI Design*, TMH, 1st edition 2013.
3. K.Lal Kishore and V.S.V. Prabhakar, “VLSI DESIGN”, IK Publishers, 1st edition 2009

Reference Books:

1. John P Uyemura, *Introduction to VLSI Circuits and Systems*, Wiley India, 2006
2. Jhon F. Wakerly, “*Digital Design Principles & Practices*”, Pearson Education Asia, 3rd Edition, 2005.
3. John M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, PHI, 2nd Edition, 1997.
4. Wayne Wolf, “*Modern VLSI Design*”, Pearson Education, 3rd Edition, 2008.
5. Sabastian smith, “*Application Specific Integrated Circuits*”, Addison Wesley Publishing Company Incorporated, 2008
6. *Principles of CMOS VLSI Design- Weste and Eshraghian*, Pearson Education, 1999

Online Resources:

1. <https://www.y2mate.com/youtube/faiEVOOCe-s>
2. <https://www.btechguru.com/courses--nptel--electronics-and-communication-engineering--advanced-vlsi-design-video-lecture--ECE--EC117101004V.html>
3. <https://www.youtube.com/watch?v=khZkhE6wJis>
4. <https://www.youtube.com/watch?v=m86zSu8vbZE>
5. <https://www.youtube.com/watch?v=W7LhLL75DYo>
6. https://www.youtube.com/watch?v=Ew1ii_XYdtg&list=PLWchUMz3kCP5xYeW4EN6V-gsYt2XrfniG

Web References:

1. <https://nptel.ac.in/courses/117/101/117101058/>
2. http://www.powershow.com/view/3d1876-Y2ViN/Design_Rules_EE213_VLSI_Design_Stick_Diagrams_VLSI_design_powerpoint_ppt_presentation
3. <http://www.faadooengineers.com/threads/2274-VLSI-Tutorial-Full-Detailed-EbookPresentation-amp-Lecture-Notes>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3005	Sensors & Actuators							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CI E	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite:Engineering Physics								
Course Objectives:								
<ol style="list-style-type: none"> 1. To Understand the basic concepts of sensors. 2. To study about the construction of various sensors. 3. To study about the various sensors types based on their applications. 4. To study about the micro level sensors 5. To study about the actuators. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the fundamentals and different types of displacement measuring sensors.(BL-2)							
CO 2	Illustrate proximity, force and pressure sensors. (BL-2)							
CO 3	Analyze the working principles of velocity, level and flow measuring sensors. (BL-3)							
CO 4	Interpret the concept of temperature, motion and light sensors. (BL-2)							
CO 5	Demonstrate working principle of micro sensors and Actuators (BL-2)							

CO-PO Mapping														
C O	P O												P S O	
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PS O 1	PS O 2
CO1	2	1	2		1		1						2	1
CO2	2	1	2		1		1						2	1
CO3	2	1	2		1		1						2	1
CO4	2	1	2		1		1						2	1
CO5	2	1	2		1		1						2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	DISPLACEMENT MEASUREMENT	10hours
Sensors - Basic requirements of sensors- Classification of sensors- Static and Dynamic characteristics of sensors-Displacement Sensors- Linear and Rotary displacement sensors- Potentiometer, Capacitive and Inductive type displacement sensor- position sensors- Optical encoder, Photoelectric sensor, Hall Effect Sensor.		
At the end of the Module 1, students will be able to:		
<ul style="list-style-type: none"> ▪ Explain the basic working of displacement sensors. (BL-2) ▪ Summarize types of displacement sensors. (BL-2) ▪ Illustrate the working principle of optical sensors. (BL-2) 		
MODULE – 2	MEASUREMENT OF PROXIMITY, FORCE PRESSURE AND FORCE	9hours
MEASUREMENT OF PROXIMITY, FORCE AND PRESSURE: Eddy current proximity sensor- Inductive Proximity sensor- Capacitive Proximity sensor -Pneumatic Proximity sensors- Proximity Switches- Contact and Noncontact type – Strain Gauge – Diaphragm Pressure Sensor- Capsule Pressure sensors- Bellows Pressure Sensor- Bourdon tube pressure sensor- Piezo-electric Sensor- Tactile sensor.		

At the end of the Module 2, students will be able to:		
<ul style="list-style-type: none"> ▪ Compare principles of proximity, force and pressure sensors. (BL-2) ▪ Explain industrial applications of these sensors. (BL-2) ▪ Demonstrate the sensing measurements of these sensors. (BL-2) 		
MODULE – 3	MEASUREMENT OF VELOCITY, FLOW AND LEVEL	9 hours
MEASUREMENT OF VELOCITY, FLOW AND LEVEL: Tachogenerator - Pyroelectric sensors - Ultrasonic sensor – Resistive sensor- Pitot tube – Orifice plate - flow nozzle- Venturi tubes – Rotameter- Electromagnetic flow meter. Float level sensor- Pressure level sensor- Variable capacitance sensor. (
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the basics of velocity, flow and level sensors. (BL-2) 2. Compare the characteristics of these sensors. (BL-2) 3. Summarize the applications. (BL-2) 		
MODULE – 4	MEASUREMENT OF TEMPERATURE, MOTION AND LIGHT	8 hours
Thermocouples- Thermistors - Thermodiodes - Thermotransistors- Bimetallic Strip- Resistance Temperature Detector- Infrared Thermography. Vibrometer and accelerometer- seismic accelerometer. Photoresistors - Photodiodes - Phototransistors- Photoconductors.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain the functioning of temperature, motion and light sensors. (BL-2) 2. Summarize the advantages of these sensors. (BL-2) 3. Outline the working of sensors in industries. (BL-2) 		
MODULE – 5	MICRO SENSORS AND ACTUATORS	12 hours
MICRO SENSORS: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.		
ACTUATORS: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. Define the principle of micro sensors. (BL-2) 2. Explain construction of micro sensors. (BL-2) 3. Explain about micro actuators. (BL-2) 4. Illustrate the industrial applications of actuators. (BL-2) 		
Total hours:		48 hours

Content beyond syllabus:			
1. Fabrication of Sensors.			
2. Plasmons.			
Self Study:			
Contents to promote self-Learning:			
	SNO	Module	Reference
	1	Displacement Transducers	https://nptel.ac.in/courses/112/103/112103174/
	2	Proximity, Force, Pressure Sensors	https://nptel.ac.in/courses/112/103/112103174/
	3	Velocity, flow and level Sensors	https://nptel.ac.in/courses/112/103/112103174/

4	Temperature and light Sensors	https://nptel.ac.in/courses/112/103/112103174/
5	Micro sensors& Actuators	http://depts.washington.edu/mictech/optics/sensors/week1a.pdf http://depts.washington.edu/mictech/optics/sensors/week1a.pdf

Text Book(s):

1. Sawhney.A.K, "Course in Mechanical Measurements and Instrumentation", Dhanpat Rai and Sons, 1997.
2. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.
3. SergejFatikowandUlrichRembold, Microsystem "Technology and Microbotics" First edition, Springer-Verlag Newyork, Inc, 1997.

Reference Book(s):

1. Thomas G. Bekwith and Lewis Buck.N, "Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
2. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997.
3. Manfred Kohl, "Shape Memory Actuators", first edition, Springer
4. Gupta.I.C, "A Text book of Engineering Metrology", Dhanpat Rai and Sons, 1996.
5. "ASTE Hand Book of Industries Metrology", Prentice Hall of India, 1992.

Web Resources/Online Resources

1. <https://nptel.ac.in/courses/112/103/112103174/>
2. <https://www.slideshare.net/nimimadhavan2/actuation-in-mems>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3006	Internet of Things (IoT)							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			C	CIE	SEE
	3	0	0	48	3	40	60	100
Pre-requisite: Basic Programming Language, Fundamentals of internet technology, computer networks,								
Course Objectives:								
<ol style="list-style-type: none"> To learn fundamentals of IoT To Learn how to build hardware To Learn software for IoT based systems To design and implement IoT circuits and solutions. Can build IoT applications. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Illustrate the general concepts of Internet of Things (IoT) (BL-2)							
CO 2	Interpret the concepts of networking & communication in IoT (BL-2)							
CO 3	Analyze IoT Models and architectures (BL-4)							
CO 4	Analyze Physical devices endpoints in IoT (BL-3)							
CO 5	Demonstrate the principles of IoT Systems for specific applications (BL-2)							

CO-PO Mapping														
CO	COURSE CONTENT												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3				1								2	1
CO2	2		1										2	
CO3	3	1											1	
CO4	2		3		2								2	
CO5	2		3		2								1	2
1: Low, 2-Medium, 3- High														

Course content		
MODULE -1	INTRODUCTION TO INTERNET OF THINGS	10hrs
The Internet of Things Today , Elements of an IoT ecosystem Time for Convergence , Characteristics of IoT, Physical design of IoT,, Logical design of IoT, IoT enabling technologies, IoT levels and deployment		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> Explain usage of the term “The Internet of Things” indifferent contexts. (BL-2) Describe the concepts of internet of things (BL-2) Explain IOT Levels (BL-2) 		
MODULE -2	NETWORKS AND COMMUNICATION:	9hrs
Networking Technology, Communication Technology, Processes Data Management, Prototyping embedded devices, Sensors and actuators, Embedded computing basics.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Explain concepts of networking & communication in IoT(BL-2) 2. Describe Basic elements in IoT (BL-2) 3. Explain embedded computing basics(BL-2) 4. What is importance of sensors and actuators in IOT(BL-2) 		
MODULE-3	IOT ARCHITECTURES	9hrs
Elements of IOT System, The IoT Reference Model, IoT Reference Architecture, The iCore Functional architecture, Privacy preserving Sharing of IoT Data		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Describe the elements of IoT System (BL-2) 2. Select the IoT & iCore Reference model, Architectures for specific applications (BL-3) 3. Explain importance of privacy in preserving and sharing of data in IoT for various applications. (BL-2) 		
MODULE-4	IOT PHYSICAL DEVICES AND ENDPOINTS	10 hrs
Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming		
Introduction to RaspberryPi, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python		
<ol style="list-style-type: none"> 1. Describe the function of Arduino (BL-2) 2. Explain fundamentals of Arduino programming(BL-2) 3. Describe configuration procedure of RaspberryPi(BL-2) 		
MODULE- 5	APPLICATIONS OF IOT	10 hrs
Home automation, Smart Cities, Smart Energy and the Smart Grid, Smart Transportation and Mobility, Industry applications- Value Creation and Challenges, Other IoT applications , Case studies in IoT system for Home automation , cities , Agriculture applications		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Explain importance of automation (BL-2) 2. Explain various applications of IOT (BL-2) 3. Describe impact of IoT in Industrial applications (BL-2) 4. Describe the Role of IoT in Smart cities (BL-2) 		
Total Hours		48hrs
Content beyond syllabus:		
<ol style="list-style-type: none"> 1. Data Analytics for IoT 		
Self-Study:		
Contents to promote self-Learning:		
SN O	Module	Reference
1	Internet of Things(IoT)	https://www.freecodecamp.org/news/introduction-to-iot-internet-of-things/ https://www.edureka.co/blog/iot-tutorial/ https://www.youtube.com/watch?v=LlhmzVL5bm8&vl=en
2	Networks and Communication	https://www.youtube.com/watch?v=LlhmzVL5bm8&vl=en https://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot.pdf

		https://www.researchgate.net/publication/336085150_A Comprehensive Survey on IoT Networking
3	Iot Architechture	https://www.avsystem.com/blog/what-is-iot-architecture/ https://www.scnsoft.com/blog/iot-architecture-in-a- nutshell-and-how-it-works https://www.youtube.com/watch?v=FRxRT0DjE7A
4	Iot Physical Devices And End points	https://www.youtube.com/watch?v=nL34zDTPkcs https://www.youtube.com/watch?v=bQYbPIaU0Cs
5	Applications of IoT	https://www.edureka.co/blog/iot-applications/ https://www.youtube.com/watch?v=OfGxbxUCa2k https://www.gsma.com/iot/smart-cities/case-studies guide/internet-of-things-examples-cases/

Text Book(s):

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things: A Hands-on-Approach", VPT, 1st Edition, 2014.
2. Ovidiu Vermesan ,Peter Friess "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", 2013 River Publishers
3. Raj Kamal, Internet of Things, First edition, McGraw Hill

Reference Book(s):

1. Jeeva Jose, Internet of Things, Khanna Book Publishing Co., New Delhi
2. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons, 1st Edition, 2014.
3. Francis Da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition, 2013.
4. Matt Richardson, Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 3rd Edition, 2014.

Online Resources/ Web References:

1. <http://nptel.ac.in/courses/106105166/>
2. https://onlinecourses.nptel.ac.in/noc17_cs22/preview
3. <https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/>
4. <https://www.youtube.com/watch?v=dC2GdEWHRxQ&list=PLy6JR9IR8VKOZBpDcETs>
 - a. H9Tb6B4bcaTXf
5. https://www.youtube.com/watch?v=kLd_JyvKV4Y
6. <https://www.youtube.com/watch?v=TkA2LJctU1c>
7. <https://webofthings.org/2016/04/24/free-book-using-the-web-to-build-the-iot/>
8. <http://spmckk.co.in/Notes/Learning%20Internet%20of%20Things.pdf>
9. <http://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies>

NARAYANA ENGINEERING COLLEGE: GUDUR								
20EC3007	MICROPROCESSORS AND MICROCONTROLLERS							R2020
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Knowledge on switching theory and logic design, basics of computer organisation, architecture and basic programming techniques.								
Course Objectives:								
<ol style="list-style-type: none"> To study the internal architecture, interrupts & memory organization of 8086 microprocessor. To understand the programming concepts using 8086. To impart the basics of the MSP 430 and its variants. To understand programming techniques using interrupts, instruction set & addressing modes To provide the knowledge on low power modes of MSP 430. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the internal architecture, memory organisation and interrupt structure of 8086 microprocessor.(BL-2)							
CO 2	Construction of a maintainable assembly language program for an algorithm. (BL-3)							
CO 3	Interpret the concepts of low power modes of MSP 430.(BL-2)							
CO 4	Develop programs using software interrupts and addressing modes of MSP430.(BL-3)							
CO 5	Compare various on chip peripherals of MAP 430.(BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	2	1	3										1	1
CO3	3		2		2								2	1
CO4	2		2		1								1	1
CO5	2	1	2										1	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	8086 MICROPROCESSOR	10 h
Introduction, Microprocessor Evolution, Intel 8086 Microprocessor: Features block diagram, Register Organization, Memory organization, Interrupts and Interrupt Vector Table.		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> List the features of 8086 microprocessor.(BL-1) Explain the architecture of 8086 microprocessor.(BL-2) Describe the memory organization of 8086 microprocessor.(BL-1) Explain the concept of interrupt handling of 8086.(BL-2) 		
MODULE 2	PROGRAMMING WITH 8086	10 h
Instruction Formats -Addressing Modes-Instruction Set of 8086, Assembler Directives, Macros and Procedures. Simple ALP's.		
At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> Explain the different addressing modes in 8086. (BL-2) Explain different instruction set of 8086 (BL-2) Implement ALPs using 8086 (BL-3) 		

MODULE-3	LOW POWER RISC MSP430	10 h
Low power RISC MSP430 block diagram, features and architecture, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Register set.		
At the end of the Module 3, students will be able to: <ul style="list-style-type: none"> 1. List the features of MSP 430 microcontroller.(BL-1) 2. Explain the architecture of MSP 430 microcontroller.(BL-2) 3. Compare variants of MSP 430. (BL-2) 		
MODULE-4	ADDRESSING MODES & INTERRUPTS OF MSP430	8 h
Addressing modes, Instruction set, Memory address space; I/O ports pull up/down resistors concepts, Interrupts and interrupt programming.		
At the end of the Module 4, students will be able to: <ul style="list-style-type: none"> 1. Apply data in MSP 430 programming using addressing modes. (BL-3) 2. Explain the instruction set of MSP 430. (BL-2) 3. Do programming using interrupts.(BL-3) 4. Lists interrupt types supported by MSP430. (BL-2) 		
MODULE-5	ON-CHIP PERIPHERALS OF MSP 430	10 h
On-chip peripherals (Analog & Digital), ADC, Comparator and data transfer using DMA controller, Watchdog timer, System clocks, Timers & Real Time Clock (RTC), Low power modes. Serial Communication Protocols: UART, USB, I2C & SPI and implementation using MSP430.		
At the end of the Module 5, students will be able to: <ul style="list-style-type: none"> 1. List the on chip peripherals of MSP 430 microcontroller.(BL-1) 2. Discuss MSP430 clock system. (BL-2) 3. Explain the operation of watchdog timer.(BL-2) 4. Explain the concept of Real Time Clock (RTC). (BL-2) 5. List the features of UART, USB, SPI, and I2C. (BL-1) 6. Explain the UART, I2C, SPI interface using MSP430. (BL-2) 		
Total hours:		48 Hours

Content Beyond syllabus:

1. ARM processor architecture: Features, Block diagram, pin diagram.
2. TIVA controller architecture: Features, Block diagram, pin diagram.

Self-Study:

Contents to promote self-Learning:

S.No	Module	Reference
1	8086 processor	https://electronicsdesk.com/8086-microprocessor.html https://circuitglobe.com/difference-between-8085-and-8086-microprocessor.html
2	Programming With 8086	http://www.ee.hacettepe.edu.tr/~alkar/ELE414/dirz2005/w6-414-[2005].pdf
3	Low Power RISC MSP 430	http://www.ece.utep.edu/courses/web3376/Notes_files/ee3376-isa.pdf
4	Addressing modes & interrupts of MSP430	https://cnx.org/contents/___autnt@1/Addressing-modes
5	On chip peripherals	http://learncontrollers.blogspot.com/2018/02/timer-of-msp430.html

		https://www.ti.com/lit/ml/slap117/slap117.pdf

Text Book(s):

1. “Microprocessor and Microcontrollers”, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publishers. Second Edition, 2016
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, I st Edition, 2008
3. “The X86 Microprocessors , Architecture, Programming and Inerfacing” , Lyla B.Das ,Pearson Publications,2010

Reference Book(s):

1. Advanced microprocessors & microcontrollers”, K M Burchandi & A K Ray, 3 rd edition, 2013
2. “Microprocessor and Interfacing: Programming and Hardware”, Douglas V.Hall, McGrawHill
3. “8086 microprocessor: Programming and Interfacing the PC”, Kenneth Ayala Cengage Learning.

Online Resources / Web References:

1. <https://nptel.ac.in/courses/108/103/108103157/>
2. <https://training.ti.com/msp430-ultra-low-power-microcontroller-overview>
3. <https://www.tutorialspoint.com/microprocessor/index.htm>
4. http://www.te.kmutnb.ac.th/~ptt/lectures/01_Microprocessors/03_MSP430/05_Tutorialv0_3.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
MICROPROCESSORS & MICROCONTROLLERS LAB							R2020	
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P			L	T	P
IV	0	0	2	42	IV	0	0	2
Pre-requisite: A course on Microprocessor and Microcontroller.								
Course Objectives:								
<ol style="list-style-type: none"> To acquire knowledge on CC studio & Launch pad. To acquire knowledge on MSP430 microcontroller instruction set. To synthesize embedded C programs using MSP430 microcontroller. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Understand the installation process of CC studio & launch pad. (BL-2)							
CO 2	Synthesize operations on MSP430 microcontroller using Code Composer Studio. (BL-3)							
CO 3	Examine power consumption of microcontroller using low power modes. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	1	1	1		1						1	1	1	
CO 2		2	2		2							2		1
CO 3				2	2									1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		CO
TASK 1: INTRODUCTION TO CODE COMPOSER STUDIO TOOL		
Objective: Introduce the code composer studio to perform any task using Mixed signal Processor.		CO1
Task-2 : ARITHMETIC OPERATIONS		
Objective: Use Embedded C programming to perform arithmetic operations such as addition, subtraction.		CO 2
Task-3: LOGICAL OPERATIONS		
Objective: Use Embedded C programming to perform logical operations such as AND, OR, XOR operations.		CO 2
Task-4: DEMO ON MSP430 LAUNCH PAD		
Objective: Introduce the MSP430 launch pad to perform operations and interface devices.		CO 1
Task-5 : BLINKING LED USING GPIO		
Objective: To Interface and programme GPIO ports in C using MSP430		CO 2
<ol style="list-style-type: none"> Blinking LEDs(Red & Green) Push buttons 		
Task-6: USAGE OF LOW POWER MODES		
Objective: Usage of Low Power Modes: Use MSPEXP430FR5969 as hardware platform and demonstrate the low power modes and measure the active mode and standby mode current.		CO 3
Task-7: INTERRUPT PROGRAMMING THROUGH GPIOs		
Objective: To verify Interrupt programming of MSP 430 through GPIOs.		CO 3
Task-8: PWM GENERATION USING TIMER ON MSP430 GPIO		

Objective: To Generate Pulse Width Modulated signal using Timer on MSP430 GPIO.	CO 3	
Task-9 : INTERFACING POTENTIOMETER WITH MSP430		
Objective: To Interface potentiometer with MSP430 to control the brightness of LED.	CO 3	
Task-10: PWM BASED SPEED CONTROL OF DC MOTOR		
Objective: To control the speed of a DC motor by potentiometer connected to MSP430 GPIO	CO 3	
Additional Experiments		
Task-1: Wi-Fi EMAIL APPLICATION		
Objective: To write an embedded C program for verifying the Wi-Fi e-mail application of MSP430 microcontroller by interfacing it with CC3100 Booster pack.	CO 2	
Task-2: MASTER SLAVE CHARACTERISTICS		
Objective: To write an embedded C program for verifying the Master-slave characteristics of MSP430 microcontroller.	CO 3	
Virtual Labs:		
<ol style="list-style-type: none"> http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php https://github.com/jishanshaikh4/Microprocessor-Virtual-Lab http://www.msec.ac.in/pages/view/mpl 		
Self-Study:		
Contents to promote self-Learning:		
SN	Topic	Reference
1	MASM	https://www.youtube.com/watch?v=m4Cxi8qhKd4
2	Assembly language programming with emulator 8086	https://www.youtube.com/watch?v=zEuvNYe7WG0
3	MSP430 launchpad	https://www.youtube.com/watch?v=V0GrBUbomDA
Text Book(s):		
<ol style="list-style-type: none"> “Microprocessor and Microcontrollers”, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publishers. Second Edition, 2016 MSP430 microcontroller basics. John H. Davies, Newnes Publication, I st Edition, 2008 “The X86 Microprocessors , Architecture, Programming and Inerfacing” , Lyla B.Das ,Pearson Publications,2010 		
Reference Book(s):		
<ol style="list-style-type: none"> Advanced microprocessors & microcontrollers”, K M Burchandi & A K Ray, 3 rd edition, 2013 “Microprocessor and Interfacing: Programming and Hardware”, Douglas V.Hall, McGrawHill “8086 microprocessor: Programming and Interfacing the PC”, Kenneth Ayala Cengage Learning. 		
Web References:		
<ol style="list-style-type: none"> https://www.ti.com/tool/MSP-EXP430G2 https://youtu.be/V0GrBUbomDA 		

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3008	WIRELESS SENSOR NETWORKS							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Nil								
Course Objectives:								
<ol style="list-style-type: none"> To introduce the characteristics, basic concepts and systems issues in Wireless sensor networks. To illustrate architecture and protocols in wireless sensor networks. To identify the trends and latest development of the technologies in the area. To provide a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks. To describe sensor node hardware 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Interpret the concepts of sensor networks for various applications.(BL-2)							
CO 2	Demonstrate wireless transmission technology and systems.(BL-2)							
CO 3	Determine the suitable medium access protocols, localization techniques and routing protocols (BL-3)							
CO 4	Compare various routing protocols and issues.(BL-2)							
CO 5	Select suitable Operating system , platform and tools for WSN (BL-4)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3												1	
CO2	3		1										1	
CO3	2		1										2	
CO4	3		3										2	
CO5	2	1	2		2								1	1
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	INTRODUCTION TO WIRELESS SENSOR NETWORKS	Hours:8
Introduction, Applications of Wireless Sensor Networks, WSN Standards, IEEE 802.15.4,Zigbee Network Architectures and Protocol Stack – Network architectures for WSN, classification of WSN, protocol stack for WSN.		
At the end of the Module 1, students will be able to:		
<ul style="list-style-type: none"> Describe wireless sensor networks and their architectures.(BL-2) Explain the applications, standards and protocols in WSN. (BL-2) Classify the WSN. (BL-2) 		
MODULE -2	WIRELESS TRANSMISSION TECHNOLOGY AND SYSTEMS	Hours: 10
Wireless Transmission Technology and Systems – Radio Technology, Available Wireless Technologies. Wireless Sensor Technology - Sensor Node Technology, Hardware and Software, Sensor Taxonomy, WSN Operating Environment.		
<ol style="list-style-type: none"> At the end of the Module 2, students will be able to: Describe wireless transmission technologies. .(BL-2) Explain the issues in WSN. .(BL-2) Explain about nodes, hardware and software in WSN. (BL-2) Describe Hardware and Software, Sensor Taxonomy.(BL-2) 		

MODULE-3	MAC PROTOCOLS FOR WIRELESS SENSOR NETWORKS	Hours: 8
Fundamentals of MAC Protocols, MAC Protocols for WSNs, Contention-Based protocols: PowerAware Multi-Access with Signaling - Data-Gathering MAC, Contention-Free Protocols: Low-Energy Adaptive Clustering Hierarchy, B-MAC, S-MAC.		
At the end of the Module 3, students will be able to: <ol style="list-style-type: none"> 1. Describe the fundamentals of MAC layer. (BL-2) 2. Explain MAC protocols. (BL-2) 3. Explain Contention-Free Protocols(BL-2) 4. List and explain Contention-Based protocols(BL-2) 		
MODULE-4	DEPLOYMENT AND CONFIGURATION	Hours: 10
Target tracking, Localization and Positioning, Coverage and Connectivity, Single-hop and Multihop Localization, Self-Configuring Localization Systems. Routing Protocols and Data Management for Wireless Sensor Networks - Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks, Routing protocols		
At the end of the Module 4, students will be able to: <ol style="list-style-type: none"> 1. Describe localization and positioning concepts.(BL-2) 2. Explain routing challenges.(BL-2) 3. Determines the efficiency of WSN. (BL-2) 4. Compare Routing Strategies In WSN(BL-2) 		
MODULE-5	ENERGY EFFICIENCY POWER CONTROL & OPERATING SYSTEM	Hours: 12
Need for energy efficiency and power control in WSN, passive power conservation mechanisms, active power conservation mechanisms. Operating System Design Issues, TinyOS, Contiki – Task management, Protothreads, Memory and IO management, Sensor Node Hardware – Tmote, Micaz, Programming Challenges, Node-level Software Platforms, Node-level Simulators		
At the end of the Module 5, students will be able to: <ol style="list-style-type: none"> 1. Describe power conservation mechanisms in WSN.(BL-2) 2. Explain the OS design issues in WSN. (BL-2) 3. Illustrate Selection OS for WSN. (BL-2) 4. Describe Memory and IO management. (BL-2) 5. Describe Sensor Node Hardware(BL-2) 		
Total hours:		48 hours

Content beyond syllabus:

1. Security Issues in WSN
2. Implementation of WSN for IOT application.

Self-Study:

Contents to promote self-Learning:

SN O	Module	Reference
1	Introduction To Wireless Sensor Networks	https://www.youtube.com/watch?v=GUSrkWJ_Z2g
2	Wireless Transmission Technology and Systems	https://www.inf.unibz.it/~ricci/MS/slides-2010-2011/9-WirelessTechnologies-P1.pdf
3	Medium Access Control Protocols for Wireless Sensor Networks	https://www.youtube.com/watch?v=Q9nez9IMC3M
4	Deployment and Configuration	https://www.youtube.com/watch?v=OaUE4otTsuc

5	Energy Efficiency Power Control & Operating System	http://hsec.cs.nthu.edu.tw/~sheujp/public/courses/course01/2005spring/Ch.%207%20Sensor%20Network%20PIatforms%20and%20Tools.pdf
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Text Book(s):

1. HolgerKerl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Network”, JohnWiley and Sons, 2005(ISBN:978-0-470-09511-9).
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, “Wireless Sensor Network”,Springer 1st Edition. 2004(ISBN:978-4020-7883-5).
3. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”,Elsevier, 1st Edition. 2004 (ISBN: 13-978-1-55860-914-3).

Reference Book(s):

- 1.Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks, Technology,Protocols and Applications”, Wiley, 2007.
- 2.Jun Zheng, Abbas Jamalipour, “Wireless Sensor Networks: A Networking Perspective”,Wiley, 2009.
- 3.Ian F. Akyildiz, Mehmet Can Vuran, “Wireless Sensor Networks”, Wiley, 2010
- 4.Ibrahiem M. M. El Emary, S. Ramakrishnan, “Wireless Sensor Networks: From Theory toApplications”, CRC Press Taylor & Francis Group, 2013.

Online Resources/ Web Resources:

1. <http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf>
2. https://www.researchgate.net/publication/261958666_Fundamentals_of_Wireless_Sensor_Networks_Theory_and_Practice
3. <http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02>
4. <http://pages.di.unipi.it/bonuccelli/sensori.pdf>
5. <https://www.elprocus.com/architecture-of-wireless-sensor-network-and-applications/>
6. https://www.csd.uoc.gr/~hy541/Lectures_files/Lectures_pdfs/CS541_Lecture1.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3009	MICRO PROCESSORS & INTERFACING						R20	
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on Integrated circuits, memories and Number systems.								
Course Objectives:								
<ol style="list-style-type: none"> To study the internal architecture, registers & memory organization of 8086 microprocessor. To understand the concept of various advanced processors like Pentium & ARM processors. To impart the basics of the MSP 430 and its variants. To identify suitable low power modes & clock systems for MSP430. To understand serial communication protocols using MSP430. 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the internal architecture, registers & memory organization of 8086 microprocessor.(BL-2)							
CO 2	Compare the architectural features of advanced processors like Pentium & ARM processors. (BL-3)							
CO 3	Summarize the features, architecture, addressing modes and instruction set of MSP 430.(BL-2)							
CO 4	Interpret the concepts of low power modes, clock system & interrupts of MSP 430.(BL-2)							
CO 5	Apply interfacing techniques for serial communication protocols using MSP 430. (BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		1										1	
CO2	3		1										1	1
CO3	2		1										1	1
CO4	2		2										1	1
CO5	3		2										1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE -1	8086 MICROPROCESSOR	10 h
Introduction, Microprocessor Evolution, Intel 8086 Microprocessor: Features, block diagram, Register Organization, Flag Register, Timing and Control Signals		
At the end of the Module 1, students will be able to:		
<ol style="list-style-type: none"> List the features of 8086 microprocessor.(BL-1) Explain the architecture of 8086 microprocessor.(BL-2) Compare the generations of microprocessors based on applications. (BL-2) List various timing & control signals available in microprocessors. (BL-1) 		
MODULE -2	ADVANCED PROCESSORS	8 h
ARM Processor (Cortex-M series) Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, core extensions, Operating Modes, ARM processor families & Applications.		

At the end of the Module 2, students will be able to:		
<ol style="list-style-type: none"> 1. Compare various versions of Pentium processors based on architecture. (BL-2) 2. List the operating modes of various advanced processors. (BL-1) 3. Explain the ARM processor internal architecture. (BL-2) 		
MODULE-3	MIXED SIGNAL PROCESSOR (MSP430)	10 h
Low power RISC MSP430 block diagram, features and architecture, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, Register set, Addressing modes, Instruction set, Memory address space.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. List the features of MSP 430 microcontroller.(BL-1) 2. Explain the architecture of MSP 430 microcontroller.(BL-2) 5. Discuss MSP 430 addressing modes of MSP430. (BL-2) 6. Explain the instruction set of MSP 430. (BL-2) 7. Compare variants of MSP 430. (BL-2) 		
MODULE-4	INTERRUPTS & LOW POWER MODES OFMSP430	10 h
I/O ports pull up/down resistors concepts, Interrupts and interrupt programming, low power modes, Active vs Standby current consumption, FRAM vs Flash for low power & reliability.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Compare the low power modes of MSP 430 microcontroller.(BL-2) 2. List the functions of pull up resistors used in MSP430. (BL-1) 3. List interrupt types supported by MSP430. (BL-1) 		
MODULE-5	INTERFACING SERIAL COMMUNICATION PROTOCOLS	10 h
Serial communication basics, Synchronous/Asynchronous protocols: UART, USB, I2C & SPI. Implementing and programming UART, I2C, SPI interface using MSP430.		
At the end of the Module 5, students will be able to:		
<ol style="list-style-type: none"> 1. List the features of UART, USB, SPI, and I2C. (BL-1) 2. Explain the UART, I2C, SPI interface using MSP430. (BL-2) 3. Compare synchronous and asynchronous interfaces. (BL-2) 		
Total hours:		48 hours

Content beyond syllabus:		
<ol style="list-style-type: none"> 1. TIVA microcontroller architecture & applications 2. Sample embedded system using MSP430 microcontroller 		
Self-Study:		
Contents to promote self-Learning:		
SNo	Module	Reference
1	8086 microprocessor	https://nptel.ac.in/courses/108/103/108103157/
2	Advanced processors	https://www.watelectronics.com/arm-processor-architecture-working/
3	Low Power RISC MSP 430	http://www.ece.utep.edu/courses/web3376/Notes_files/ee3376-isa.pdf
4	Interrupts and Low power of MSP 430	https://www.argenox.com/library/msp430/msp430-interrupts-and-low-power-chapter-7/

5	Serial communication	https://www.ti.com/lit/ml/slap117/slap117.pdf
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Text Book(s):

1. “Microprocessor and Microcontrollers”, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford Publishers, Second Edition, 2016
2. MSP430 microcontroller basics. John H. Davies, Newnes Publication, 1st Edition, 2008
3. “The X86 Microprocessors , Architecture, Programming and Interfacing” , Lyla B. Das , Pearson Publications, 2010

Reference Book(s):

1. Advanced microprocessors & microcontrollers”, A K Ray, K M Burchandi 3rd edition, 2013.
2. “Microprocessor and Interfacing: Programming and Hardware”, Douglas V. Hall, McGraw Hill
3. “8086 microprocessor: Programming and Interfacing the PC”, Kenneth Ayala, Cengage Learning

Online Resources / Web References:

1. <https://nptel.ac.in/courses/108/103/108103157/>
2. <https://training.ti.com/msp430-ultra-low-power-microcontroller-overview>
3. <https://www.youtube.com/watch?v=SNj5aCnrUU&feature=youtu.be&t=10>
4. <https://www.tutorialspoint.com/microprocessor/index.htm>
5. http://www.te.kmutnb.ac.th/~ptt/lectures/01_Microprocessors/03_MSP430/05_Tutorialv0_3.pdf

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3010	DATA COMMUNICATIONS & NETWORKING							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Programming Course, Introduction to Operating Systems Course, Network Communication Course, Wireless Communications Course.								
Course Objectives:								
<ol style="list-style-type: none"> To understand the basics of data communication and various network categories To Demonstrate different switching datagram networks To interpret different multiple access techniques To outline the importance of network layer To summarize the significance of transport layer To Illustrate various technologies like SONET, STS Multiplexing, ATM 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basics of data communication and various network categories. (BL-02)							
CO 2	Analyze the switching datagram networks. (BL-03)							
CO 3	Interpret different multiple access techniques. (BL-02)							
CO 4	Outline the importance of network layer. (BL-02)							
CO 5	Analyze the significance of transport layer. (BL-04)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3													
CO2	2		1										1	1
CO3	3		2										2	2
CO4	2	1	1										1	1
CO5	2	1	1										2	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-1	INTRODUCTION	08HRS
<p>Introduction, components and characteristics of data communication, data representation, Data Transmission mode-simplex, half duplex, full duplex, Difference between Digital and Data Communication, Serial and parallel data transmission, Multiplexing.</p> <p>Introduction to networks: Definition of Computer Network, Applications of Computer Networks, Categories Networks-LAN, MAN and WAN , Concept of Protocol , Open System Interconnection (OSI) Model, TCP / IP.</p>		
<p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> Understand various data transmission modes. (BL-02) Compare digital and data communication (BL-02) List the various applications of computer networks. (BL-01) Explain the OSI Model. (BL-02) 		

MODULE-2	SWITCHING CONCEPTS	08HRS
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<p>Virtual Circuit Networks, Structure of a switch, Ethernet Physical Layer, Data Link Layer-Error detection and Correction.</p> <p>Data Link Control: Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol.</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. understand the concept of virtual circuit networks (BL-02) 2. Explain error detection and correction(BL-02) 3. Compare noisy and noiseless channels. (BL-02) 4. Illustrate the point to point protocol. (BL-02) 		
MODULE-3	Multiple Access Technologies	08HRS
<p>RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization, Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN, IEEE 802.11, Bluetooth IEEE 802.16</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the different multiple accessing techniques. (BL-02) 2. List the various IEEE Standards.(BL-01) 3. Understand the concept of Fast Ethernet(BL-02) 4. Compare the standard Ethernet with the fast Ethernet. (BL-02) 		
MODULE-4	Network Layer	08 HRS
<p>Design Issues, Routing Algorithms, congestion control algorithms, IPV4 Addresses, connecting Devices, Virtual LAN IPV6 Addresses, Internet Protocol, Hardware Addressing versus IP Addressing, IP Data Gram.</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Outline the design issues of network layer (BL-02) 2. Explain the concept of routing algorithms(BL-02) 3. Compare Hardware Addressing versus IP Addressing. (BL-02) 4. Understand the concept of IP data gram(BL-02) 		
MODULE-5	Transport Layer	08HRS
<p>Transport Layer Protocol, User Datagram Protocol(UDP) and Transmission Control Protocol(TCP), Automated Teller Machine(ATM), Cryptography-Introduction, types and applications, Network Security-levels and types, Cellular telephony; SONET / SDH</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain TCP and UDP protocols. (BL-02) 2. Understand the basic concepts of cryptography. (BL-02) 3. Outline the features of ATM(BL-02) 4. List the features of cryptography (BL-01) 5. understand the concept of SONET (BL-02) 		
Total hours:		48 hours

Content beyond syllabus:

1. PAN(PERSONAL AREA NETWORK) wireless networks
2. LAN(LOCAL AREA NETWORK) wireless networks
3. MAN(METROPOLITIAN AREA NETWORK) wireless networks

4.WAN(WIDE AREA NETWORK) wireless networks

Self-Study:

Contents to promote self-Learning:

SN O	Module	Reference
1	Introduction to Data Communication and Networks	https://www.tutorialspoint.com/data_communication_computer_network/index.htm https://www.youtube.com/watch?v=EzLMMsRR6Js https://www.youtube.com/watch?v=P3hSzZR_Zuc
2	Switching Concepts	https://www.javatpoint.com/computer-network-switching-techniques https://www.youtube.com/watch?v=kKCwkRT_U8I https://www.youtube.com/watch?v=7PtTn38f4os
3	Multiple Access Technologies	https://www.electronicdesign.com/technologies/communications/article/21802209/fundamentals-of-communications-access-technologies-fdma-tdma-cdma-ofdma-and-sdma https://www.youtube.com/watch?v=MzL8lOlGgUc https://www.youtube.com/watch?v=RSq4nY8QdG8
4	Network Layer	https://www.tutorialspoint.com/data_communication_computer_network/network_layer_introduction.htm https://www.youtube.com/watch?v=O--rkQNKqls&list=PLEAYkSg4uSQ2NMmzNNsEK5RVbhxqx0BZF https://www.youtube.com/watch?v=PjWrq7oJgxE
5	Transport Layer	https://www.geeksforgeeks.org/network-security/?ref=rp https://www.youtube.com/watch?v=fQ3ESFfvchg&list=PLUtfVcb-iqn834VGI9faVXGIGSDXZMGp8

Text Book(s):

1. Wayne Tomasi, "Introduction to Data Communications and Networking", 2005, Pearson Education, India.
2. Fred Halsall, Lingana Gouda Kulkarni(2006), Computer Networking and the Internet, 5th edition, Pearson Education India, New Delhi, India.
3. Behrouz A Forouzan, DebddeepMukhopadhyay, "Cryptography and NetworkSecurity", 2nd edition, Tata McGraw Hill, India.

Reference Book(s):

1. Behrouz A Forouzan (2007), Data Communications and Networking, 4th edition, TataMcGraw Hill, India
2. A. S. Tanenbaum, "Computer Networks", PHI.
W. Stallings, "Data and Computer Communication", PHI

Online Resources/Web References:

1. <https://nptel.ac.in/courses/106/105/106105082/> (IIT kharagpur)
2. <https://nptel.ac.in/courses/117/105/117105076/>
3. <http://www.nptelvideos.in/2012/11/data-communication.html>
1. https://www.youtube.com/watch?v=_EkMcx2LflU
2. <https://www.youtube.com/watch?v=xtrWSWbEYWE>
3. http://library.aceondo.net/ebooks/Computer_Science/Data_Communication_and_Networking_by_Behrouz.A.Forouzan_4th.edition.pdf
7. http://archive.mu.ac.in/myweb_test/syllFybscit/dcn.pdf
8. <https://www.javatpoint.com/computer-network-switching-techniques>
9. https://www.tutorialspoint.com/data_communication_computer_network/index.htm
10. https://web.sonoma.edu/esee/courses/ee442/lectures/sp2017/lect13_multiple_access.pdf
11. <https://www.geeksforgeeks.org/design-issues-in-network-layer/?ref=leftbar-rightbar>
12. <https://www.tutorialspoint.com/cryptography/index.htm>
13. <https://www.tutorialspoint.com/ATM-Networks>
14. https://www.researchgate.net/publication/248381994_On_IEEE_80211_Wireless_Lan_Technology

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3011	DIGITAL LOGIC DESIGN							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on number system and algebra.								
Course Objectives:								
<ol style="list-style-type: none"> To study the basic concepts of number systems and binary codes. To minimize Boolean expressions using map and Q-M method. To design combinational and sequential circuits. To familiarize Registers & counters using Flip-Flops. To understand the concept of memory organization 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Demonstrate the basic number systems, binary codes and Boolean algebra (BL-2)							
CO 2	Apply minimization techniques on Boolean expressions. (BL-3)							
CO 3	Design combinational circuits using logic gates (BL-3)							
CO 4	Analyze synchronous sequential circuits. (BL-4)							
CO 5	Illustrate the classification of memories and programmable logic devices (BL-2)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2											1
CO2	2	2	2										1	
CO3	2	2	2										1	1
CO4	2	2	2										2	1
CO5	2	1	1										1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	NUMBER SYSTEMS & BOOLEAN ALGEBRA	10h
Number Systems: Introduction, Number Systems, Number base conversions, 1's and 2's Complements, BCD code, Excess -3 codes, Gray code, ASCII code, Error Detection and Correction Codes.		
Boolean Algebra: Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, Logic gates, implementation of Boolean functions using logic gates		
At the end of the Module 1, students will be able to: <ol style="list-style-type: none"> List number systems. (BL-1) Illustrate different code conversions. (BL-2) List Theorem's and properties of Boolean algebra (BL-1) Explain the functionality of logic gates (BL-2) 		
MODULE -2	SIMPLIFICATION OF BOOLEAN FUNCTIONS	8h
Introduction, Karnaugh map simplification, Don't care conditions, Prime Implicants, Quine-McCluskey method Simplification, NAND & NOR Implementations, Two Level Implementations.		
At the end of the Module 2, students will be able to: <ol style="list-style-type: none"> Apply basic laws and De Morgan's theorems to simplify Boolean expressions (BL-3) Explain map and Q-M method to minimize Boolean expressions. (BL-2) Implement Boolean expression using universal gates. (BL-3) 		

4. Implement Boolean expression using two level methods. (BL-3)		
MODULE-3	COMBINATIONAL CIRCUITS	10h
Introduction, Design Procedure, Adders, Sub tractor, Binary Adder-Sub tractor, BCD Adder, Binary Multiplier, Magnitude Comparator, Multiplexers, De-multiplexers, Decoders, Encoders and Code Converters.		
At the end of the Module 3, students will be able to:		
<ol style="list-style-type: none"> 1. Design combinational logic circuits. (BL-3) 2. Implement Boolean expression using multiplexer. (BL-3) 3. Implement higher order MUX using lower order MUX.(BL-3) 4. Design code converters using gates. (BL-3) 		
MODULE-4	SEQUENTIAL CIRCUITS	12h
Introduction, Latches, Flip-flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-Flop conversions, Design of Synchronous Sequential Circuits: State Equations, State Table, State reduction, State assignment, State diagram , Mealy and Moore machine models, Registers, Shift Registers, Counters: Synchronous counters, Asynchronous counters & other counters.		
At the end of the Module 4, students will be able to:		
<ol style="list-style-type: none"> 1. Describe behavior of latches & flip flops. (BL-2) 2. Analyze the flip-flop conversions(BL-3) 3. Analyze synchronous sequential circuits. (BL-3) 4. Explain the design procedure of sequential circuits(BL-2) 5. Design synchronous sequential circuits using state reduction & assignment process. (BL-3) 		
MODULE-5	MEMORY & PROGRAMMABLE LOGIC DEVICES	8h
Introduction, Random Access Memory, Types of RAM, Memory decoding, Read Only Memory, Types of ROM, Flash memory, Programmable Logic Devices (PLDs): Basic concepts, Programmable Read Only Memory (PROM), Programmable Array Logic (PAL) and Programmable Logic Array(PLA).		
At the end of the Module 6, students will be able to:		
<ol style="list-style-type: none"> 1. Explain PROM, PAL and PLA. (BL-2) 2. Compare digital logic families. (BL-2) 3. Illustrate the characteristics of digital IC's . (BL-2) 		
Total hours:		48 hours

Content beyond syllabus:

1. Representation of signed & unsigned binary numbers in digital computer
2. Binary subtraction operation using 1's and 2's complement methods in digital circuits

Self-Study:

Contents to promote self-Learning:

SNO	Module	Reference
1	Number systems	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2	Simplification of Boolean functions	https://www.electrical4u.com/simplifying-boolean-expression-using-k-map/ https://www.electronicshub.org/k-map-karnaugh-map
3	Combinational circuits	https://www.allaboutcircuits.com/textbook/digital/

4	Sequential Circuits	https://www.electronics-tutorials.ws/sequential/seq_1.html https://technobyte.org/counters-up-down-synchronous-asynchronous/
5	Programmable logic devices	https://www.tutorialspoint.com/digital_circuits/digital_circuits_programmable_logic_devices.htm

Text Book(s):

1. M. Morris Mano, M.D. Ciletti, "Digital Design", 5th edition, Pearson, 2018.
2. R. P. Jain, "Modern Digital Electronics", 4th edition, McGraw Hill Education (India Private Limited), 2012.
3. Anil K. Maini, "Digital Electronics: Principles, Devices and Applications", Willey, 2007

Reference Book(s):

1. Anand Kumar, Switching Theory and Logic Design, PHI,2008
2. Charles H. Roth, Fundamentals of Logic Design, Thomson Publications, 5thEdition, 2004.
3. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

Online Resources / Web References:

1. <https://nptel.ac.in/courses/108/105/108105113/> (IIT- Kharagpur – digital Circuits)
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-004-computation-structures-spring-2017/c4/>
3. <https://nptel.ac.in/courses/106/105/106105185/>(IIT- Kharagpur – Switching Circuits and Logic Design)
4. https://www.researchgate.net/publication/264005171_Digital_Electronics
5. https://www.academia.edu/37445384/Anil_K._Maini_Digital_Electronics_Principles_01.04.16.pdf
6. https://intuitionke.weebly.com/uploads/1/1/8/2/118271274/digital_principles_switching_theory.pdf
7. <https://www.javatpoint.com/digital-electronics>

NARAYANA ENGINEERING COLLEGE:GUDUR								
20EC3012	PRINCIPLES OF COMMUNICATION							R20
Semester	Hours / Week			Total hrs	Credit C	Max Marks		
	L	T	P			CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100
Pre-requisite: Basic knowledge on analog and digital signals								
Course Objectives:								
<ol style="list-style-type: none"> To understand the classification of electronic communication systems, various sources and types of noise. To summarize the different amplitude modulation techniques. To compare angle modulation techniques. To understand the concept of sampling and various pulse modulation techniques To select the appropriate modulation and demodulation techniques for transmission and reception of digital signals To apply various coding techniques for obtaining maximum coding efficiency 								
Course Outcomes: After successful completion of the course, the student will be able to:								
CO 1	Summarize the different amplitude modulation techniques. (BL-2)							
CO 2	Explain the angle modulation techniques (BL-2)							
CO 3	Illustrate the concept of sampling and various pulse modulation techniques (BL-2)							
CO 4	Select the appropriate modulation and demodulation techniques for transmission and reception of digital signals(BL-3)							
CO 5	Apply various coding techniques for obtaining maximum coding efficiency(BL-3)							

CO-PO Mapping														
CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	1												
CO2	3	2	1										2	1
CO3	3	1	2										1	1
CO4	3	1											1	1
CO5	2	2	2										1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	AMPLITUDE MODULATION	10Hrs
<p>Elements of communication system, classification of electronic communication systems, Sources of information, Analog, Digital and Pulse signals, Message, Information.</p> <p>Amplitude Modulation: Definition of modulation, Time domain and frequency domain representation of AM signal, Generation and Demodulation of AM waves, Bandwidth and power relations, Generation and demodulation of DSB-SC&SSB-SC, Comparison of amplitude modulation techniques.</p>		
<p>At the end of the Module 1, students will be able to:</p> <ol style="list-style-type: none"> Understand the elements of communication system (BL-2) Summarize the types of electronic communication systems (BL-2) 		

<ol style="list-style-type: none"> 3. Explain the concept and need of modulation. (BL-2) 4. Outline the different modulation systems. (BL-2) 5. Compare different amplitude modulation techniques. (BL-2) 		
MODULE-2	ANGLE MODULATION	10Hrs
<p>Introduction to angle modulation, Frequency and Phase modulations, Advantages of FM over AM, Bandwidth considerations, Narrow Band and Wide Band FM, Generation of FM waves – Direct method, Indirect method, Demodulation of FM: Slope demodulators, Foster-Seelay demodulator.</p> <p>Noise: Sources of noise, Classification of noise, Noise bandwidth, Signal to noise ratio, Noise temperature, noise figure and Power spectral density</p>		
<p>At the end of the Module 2, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain different angle modulation techniques. (BL-2) 2. Outline the advantages of FM over AM. (BL-2) 3. Compare FM and PM. (BL-2) 4. Explain various noise sources and parameters.(BL-2) 		
MODULE-3	SAMPLING THEORY AND PULSE MODULATION	10Hrs
<p>Sampling theory: Introduction, Sampling theorem for band limited signals, Nyquist rate and Nyquist interval, Sampling techniques.</p> <p>Pulse Modulation: Pulse amplitude modulation (PAM) & demodulation, Pulse Width and Pulse Position modulations and demodulation schemes, Multiplexing-Frequency Division Multiplexing, Time Division Multiplexing.(Qualitative treatment only)</p>		
<p>At the end of the Module 3, students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concept of sampling and nyquist interval. (BL-2) 2. Summarize different sampling techniques. (BL-2) 3. Explain various pulse modulation techniques. (BL-2) 4. Compare FDM and TDM. (BL-2) 		
MODULE-4	DIGITAL TRANSMISSION AND MODULATION	09 Hrs
<p>Digital Transmission: Base band digital signals, Advantages of digital communication, Block diagram of PCM, Quantization, Effect of quantization, Quantization error, DM, ADM and comparison.(Qualitative treatment only)</p> <p>Digital Modulation: ASK, FSK, PSK, Modulation and Demodulation - Coherent and Non-coherent techniques. (Qualitative treatment only)</p>		
<p>At the end of the Module 4, students will be able to:</p> <ol style="list-style-type: none"> 1. Outline the advantages of digital communication. (BL-2) 2. Compare different digital communication techniques. (BL-2) 3. Explainvarious digital modulation techniques. (BL-2) 		
MODULE-5	INFORMATION THEORY AND CODING	09Hrs
<p>Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding, Error Control Coding, Error Detection and Correction Codes, Block Codes. (Qualitative treatment only)</p>		
<p>At the end of the Module 5, students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the concept of information and entropy. (BL-2) 2. Apply various coding techniques to achieve maximum coding efficiency. (BL-3) 3. Explain error detection and correction codes. (BL-2) 		

Content beyond syllabus:

1. Radio receivers
2. Frequency mixers
3. Cyclic & Convolution Codes

Self-Study:

Contents to promote self-Learning:

S. No.	Module	Reference
1	Amplitude Modulation	https://byjus.com/jee/amplitude-modulation/ https://www.electronics-notes.com/articles/radio/modulation/amplitude-modulation-am.php https://www.youtube.com/watch?v=wqTv6jdUPL4 https://www.wisdomjobs.com/e-university/principles-of-communication-tutorial-2513/principles-of-communication-introduction-26223.html https://www.youtube.com/watch?v=w8aXURSa4ME
2	Angle Modulation	https://www.tutorialspoint.com/analog_communication/analog_communication_angle_modulation.htm https://www.youtube.com/watch?v=YS9I2U6z4cA&list=PLgwJf8NK-2e5k2hI8zRal2rffvo7QknyC
3	Sampling Theory and Pulse Modulation	https://www.tutorialspoint.com/digital_communication/digital_communication_sampling.htm https://www.youtube.com/watch?v=VZ23yvTNjGI https://www.electronicshub.org/modulation-and-different-types-of-modulation/ https://www.youtube.com/watch?v=TM47sEXeaj8&t=288s
4	Digital Transmission and Modulation	https://www.tutorialspoint.com/digital_communication/digital_communication_analog_to_digital.htm https://www.youtube.com/watch?v=aKl17gw_nfU https://www.tutorialspoint.com/digital_communication/digital_communication_digital_modulation_techniques.htm https://www.youtube.com/watch?v=ucrZlde8vTk
5	Information Theory and Coding	https://www.tutorialspoint.com/digital_communication/digital_communication_information_theory.htm https://youtu.be/18E3NlIObqg?list=PLOjJqTT3gfANyo6RxoGfNqJXT86vaFMIL

Text Book(s):

1. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw Hill Publication.
2. R.P. Singh and S D Sapre, Communication Systems – Analog and Digital, TMH, 2nd edition 2007.
3. Simon Haykin, Communication Systems, John Wiley, 2nd edition 2007.

Reference Book(s):

1. Communication Systems Engineering – John. G. Proakis and Masoud Salehi, PHI, 2nd Ed. 2004.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press.
3. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley, 2006.

Online Resources / Web Resources:

1. <https://nptel.ac.in/courses/117/101/117101051/>
2. <https://nptel.ac.in/courses/108/104/108104091/>
3. <https://nptel.ac.in/courses/108/104/108104098/>
4. <http://e4uhu.com/down/communication%20electronics/Book%204th.pdf>
5. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_introduction.htm
6. <https://ict.iitk.ac.in/wp-content/uploads/EE320A-Principles-Of-Communication-modern-digital-and-analog-communication-systems-by-b-p-lathi.pdf>
7. <https://books.google.co.in/books?id=cI6y-d-yN1IC&printsec=frontcover&dq=PRINCIPLES+OF+COMMUNICATION&hl=en&sa=X&ved=0ahUKEwjCqJGf9pPnAhUpyzgGHUsOCzEQ6AEIMTAB#v=onepage&q=PRINCIPLES%20OF%20COMMUNICATION&f=false>
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