Department of
Electronics and Communication Engineering

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FACULTY OF ENGINEERING AND TECHNOLOGY

B.TECH. - ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION 2018, REVISION 1

FOUR YEAR FULL TIME

BATCH : 2018 - 2022

CURRICULUM AND SYLLABUS

I – VIII SEMESTERS

APPROVAL	
BOS	**32nd ACM**
22.04.2019	31.05.2019

VISION	To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.

MISSION	**UM1**	Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
	UM2	Providing student - centered education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
	UM3	Involving progressive and meaningful research with concern for sustainable development.
	UM4	Enabling the students to acquire the skills for global competencies.
	UM5	Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.

CORE VALUES

- Student – centric vocation
- Academic excellence
- Social Justice, equity, equality, diversity, empowerment, sustainability
- Skills and use of technology for global competency.
- Continual improvement
- Leadership qualities.
- Societal needs
- Learning, a life – long process
- Team work
- Entrepreneurship for men and women
- Rural development
- Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION	To be an innovative leading department in the domain of Electronics and Communication Engineering in promoting academic growth by offering UG, PG and Ph.D Programmes to augment the industrial and societal needs through cutting edge research activities

MISSION	**DM1**	To offer UG, PG and Ph.D programmes in Electronics and Communication Engineering through State-of-art facilities and Technology Enabled Teaching Methodologies.
	DM2	To produce Exemplary Electronics and Communication Engineers to meet the contemporary requirements of the industries and institutions.
	DM3	To excel in research and development activities along with establishing collaborative research ventures and linkages with leading organizations.
	DM4	To cultivate entrepreneurial skill and concern for society among students.

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM1	**UM2**	**UM3**	**UM4**	**UM5**
DM1	3	2	0	1	1
DM2	1	2	1	3	1
DM3	1	1	3	3	0
DM4	0	1	1	1	3
Total	**5**	**6**	**4**	**8**	**5**

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1	Graduates will be successful Electronics and Communication Engineering Professionals in industries, higher education and research.
PEO2	Graduates will be technically competent in identifying, analyzing and creating appropriate Electronics and Communication Engineering solutions to become an entrepreneur.
PEO3	Graduates will work as a member and lead following ethical practices.
PEO4	Graduates will strive to develop their knowledge and skills throughout their career for the benefit of the society.

Table: 2 Mapping of Program Educational Objectives (PEOs) with Department Mission (DM)

PEO / DM	DM1	DM 2	DM 3	DM4
PEO 1	3	2	1	1
PEO 2	2	3	1	1
PEO 3	0	2	2	2
PEO 4	0	1	1	3
	5	**8**	**5**	**7**

1- Low 2 – Medium 3-High

GRADUATE ATTRIBUTES

1. **Knowledge base for Engineering:** Demonstrate competence in mathematics, natural sciences, engineering fundamentals and specialized engineering knowledge appropriate to the program.
2. **Problem Analysis:** Identify, formulate, analyze and solve diverse engineering problems.
3. **Design:** Solution for complicated open–ended engineering problems and design the components with appropriate standards to meet specified needs with proper attention to public health, safety, environment and society.
4. **Experimental Investigation:** Technical skills to conduct investigation, interpretation of observed data and provide solution for multifaceted problems.
5. **Modern Engineering tools usage**: Acquire, select, manipulate relevant techniques, resources and advanced engineering ICT tools to operate simple to complex engineering activities.
6. **Impact of engineering on society:** Provide a product / project for use by the public towards their health, welfare, safety and legal issues to serve the society effectively.
7. **Environment and Sustainability:** Design eco-friendly and sustainable products in demonstrating the technology development to meet present and future needs.
8. **High Ethical Standards:** Practice ethical codes and standards endorsed by professional engineers.
9. **Leadership and team work:** Perform as an individual and as a leader in diverse teams and in multi-disciplinary scenarios.
10. **Communication Skills:** Professional communication with the society to comprehend and formulate reports, documentation, effective delivery of presentation and responsible to clear instructions.
11. P**roject management and Finance:** Appropriate in incorporating finance and business practices including project, risk and change management in the practice of engineering by understanding their limitations.
12. **Life-long learners:** Update the technical needs in a challenging world in equipping themselves to maintain their competence.

PROGRAM OUTCOMES (POs)

1. Able to apply the knowledge of Mathematics, Science, Engineering and Technology in the field of Electronics and Communication Engineering
2. Capable to identify and analyse the Electronics and Communication engineering problems.
3. Proficient to provide solutions to meet the specific needs of the public health, safety, environment and society.
4. Competent to conduct experiments, interpret the data and compare the performance and provide solutions for complex problems.
5. Adept to handle modern Electronics and Communication Engineering tools, equipments and software.
6. Skillful to design Electronics and Communication products and validate by analysis and test for the benefit of the society towards safety and legal issues.
7. Efficient to develop a Electronics and Communication system or process to meet the economical growth, eco friendly environment and sustainability.
8. Instill to integrate professional, ethical and social responsibility in all walks of life.
9. Masterful to lead the group activities or as a team member for best outputs.
10. Effective to comprehend and formulate reports, deliver presentations and respond to the queries with clear ideas.
11. Capable to incorporate business practices and project management for the economical growth of the nation.
12. Able to update technical knowhow and engage in lifelong learning to meet the challenges of the modern world.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

13. (PSO1) Will be able to specialize in networking practice.
14. (PSO2) will be able to specialize in Wireless Communications pertaining to physical layer.

Mapping of Program Outcomes (POs) with Graduate Attributes (GAs)

PO/GA	GA 1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA 10	GA 11	GA 12
PO1	3	1	0	0	1	0	0	0	0	0	0	0
PO2	1	3	1	1	1	0	0	0	0	0	0	0
PO3	1	1	3	1	1	0	0	0	0	0	0	0
PO4	1	1	1	3	1	0	0	0	0	0	0	0
PO5	1	1	1	1	3	0	0	0	0	0	0	0
PO6	1	1	1	1	1	3	0	0	0	0	0	0
PO7	1	1	1	1	1	1	3	1	0	0	0	0
PO8	0	0	0	0	0	1	1	3	1	0	0	0
PO 9	0	0	0	0	0	0	0	0	3	1	0	0
PO10	0	0	0	0	0	0	0	0	1	3	1	0
PO11	1	1	1	0	1	0	0	0	0	0	3	0
PO12	1	1	1	1	1	0	0	0	0	0	0	3
PSO1	2	2	2	2	2	2	2	0	0	0	0	2
PSO2	2	2	2	2	2	2	2	0	0	0	0	2

0-Relation 1- Low Relation 2 – Medium Relation 3-High Relation

Table 3 Mapping of Program Outcomes (POs) with Program Educational Objectives (PEOs)

PEO / PO	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
PEO 1	3	3	2	3	3	2	1	0	0	1	2	0	2	2
PEO 2	2	3	2	3	3	2	2	0	1	3	2	3	2	2
PEO 3	0	0	1	0	0	1	2	1	3	0	3	3	2	2
PEO 4	2	2	1	1	2	3	2	3	1	1	3	0	2	2

0-No Relation 1- Low Relation 2 – Medium Relation 3-High Relation

B.Tech ECE - Curriculum and Syllabus from I to VIII Semesters (Regulation 2018, Revision 1)

SEMESTER I

Course Code	Category	Name of the Course	Credits				Hours			
			L	T	P	C	L	T	P	Total
XMA101	BSC	Calculus and Linear Algebra	3	1	0	4	3	1	0	4
XCP102	ESC	Programming for Problem Solving	3	0	2	5	3	0	4	7
XGS103	HSMC	English	3	0	0	3	3	0	0	3
XAC104	BSC	Applied Chemistry for Engineers	3	1	1	5	3	1	2	6
XWP105	ESC	Workshop Practices	1	0	2	3	1	0	4	5
Total			13	2	5	**20**	13	2	10	**25**

Total Credits - 20

SEMESTER II

Course Code	Category	Name of the Course	Credits				Hours			
			L	T	P	C	L	T	P	Total
XMA201	BSC	Calculus, Ordinary Differential Equations and Complex Variable	3	1	0	4	3	1	0	4
XES202	UGC M	Environmental Sciences*#	0	0	0	0	3	0	0	3
XBE203	ESC	Electrical and Electronics Engineering Systems	3	1	1	5	3	1	2	6
XAP204	BSC	Applied Physics for Engineers	3	1	2	6	3	1	3	7
XEG205	ESC	Engineering Graphics	2	0	1	3	2	0	2	4
Total			11	3	4	**18**	14	3	7	**24**

Total Credits - 18

SEMESTER III

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XMA301	BSC	Transforms and Partial Differential Equations	3	1	0	4	3	1	0	4
XEC302	PC	Electronic Devices	3	0	0	3	3	0	0	3
XEC303	PC	Digital System Design	3	0	0	3	3	0	0	3
XEC304	PC	Signals and Systems	3	0	0	3	3	0	0	3
XUM305	HSMC	Entrepreneurship Development	2	0	0	2	2	0	0	2
XUM306	UGCM	Constitution of India*#	0	0	0	0	3	0	0	3
XEC307	PC	Network Theory	3	0	0	3	3	0	0	3
XEC308	PC	Electronics Devices and Networks Lab	0	0	1	1	0	0	2	2
XEC309	PC	Digital System Design Lab	0	0	1	1	0	0	2	2
XEC310	IPT	In Plant Training – 1	0	0	0	0	0	0	0	0
Total			17	1	2	**20**	20	1	4	**25**

Total Credits - 20

SEMESTER IV

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XEC401	BSC	Probability Theory and Stochastic Processes	3	1	0	4	3	1	0	4
XUM402	HSMC	Total Quality Management	2	0	0	2	2	0	0	2
XUM403	UGCM	Human ethics, values, rights and gender equality*#	0	0	0	0	3	0	0	3
XEC404	PC	Electro dynamics and Electromagnetic Waves	3	0	0	3	3	0	0	3
XEC405	PC	Transmission Lines and Waveguides	3	0	0	3	3	0	0	3
XEC406	PC	Analog Communication	3	0	0	3	3	0	0	3

XEC407	PC	Electronic Circuits	3	0	0	3	3	0	0	3
XEC408	PC	Microprocessors and Microcontrollers	3	0	0	3	3	0	0	3
XEC409	PC	Electronic Circuits Lab	0	0	1	1	0	0	2	2
XEC410	PC	Microprocessors and Microcontrollers Lab	0	0	1	1	0	0	2	2
Total			20	1	2	**23**	23	1	4	**28**

Total Credits - 23

SEMESTER V

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XEC501	PC	Analog Integrated Circuits	3	0	0	3	3	0	0	3
XEC502	PC	Digital Communication	3	0	0	3	3	0	0	3
XEC503	ESC	Computer Architecture and Organisation	3	0	0	3	3	0	0	3
XEC504	PC	Digital Signal Processing	3	0	0	3	3	0	0	3
XEC505	PE	Professional Elective-1*	3	0	0	3	3	0	0	3
XOE506	OE	Open Elective - 1**	3	0	0	3	3	0	0	3
XGS507	HSM	Effective Technical Communication	0	0	1	1	0	0	2	2
XEC508	PC	Analog Integrated Circuits Lab	0	0	1	1	0	0	2	2
XEC509	PC	Analog and Digital Communication Lab	0	0	1	1	0	0	2	2
XEC510	PC	Digital Signal Processing Lab	0	0	1	1	0	0	2	2
XEC511	IPT	In Plant Training – 2	0	0	0	0	0	0	0	0
XECM01	Minor	PCB Design through ULTIBOARD*#	0	0	0	0	0	0	2	2
Total			18	0	4	**22**	18	0	10	**28**

Total Credits - 22

SEMESTER VI

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XUM601	HSM	Economics for Engineers	2	0	0	2	2	0	0	2
XEC602	PC	Control Systems	3	0	0	3	3	0	0	3
XEC603	PC	Antennas and Wave Propagation	3	0	0	3	3	0	0	3
XEC604	PE	Professional Elective–2*	3	0	0	3	3	0	0	3
XOE605	OE	Open Elective - 2**	3	0	0	3	3	0	0	3
XUM606	UGC	Disaster Management	0	0	0	0	3	0	0	3
XEC607	PC	VLSI Design and Embedded Systems	3	0	0	3	3	0	0	3
XEC608	PC	VLSI Design and Embedded Systems Lab	0	0	1	1	0	0	2	2
XEC609	PC	Mini Project	0	0	2	2	0	0	4	4
XECM02	Minor	PLC and Sensorics*#	0	0	0	0	0	0	2	2
Total			17	0	3	**20**	20	0	8	28

Total Credits - 20

SEMESTER VII

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XUM701	UGC	Cyber Security*#	0	0	0	0	3	0	0	3
XEC702	PC	Microwave Engineering and Fiber Optic Communication	3	0	0	3	3	0	0	3
XEC703	PE	Professional Elective-3*	3	0	0	3	3	0	0	3
XEC704	PE	Professional Elective-4*	3	0	0	3	3	0	0	3
XOE705	OE	Open Elective–3**	3	0	0	3	3	0	0	3
XEC706	PC	Microwave Engineering and Fiber Optic Communication Lab	0	0	1	1	0	0	2	2
XEC707	Project	Project Work Phase - I	0	0	8	4	0	0	10	10
XEC708	IPT	In Plant Training – 3	0	0	4	2	0	0	0	0
XECM03	Minor	MATLAB for Wireless Communication*#	0	0	0	0	0	0	2	2
		Total	12	0	13	**19**	15	0	14	29

Total Credits - 19

SEMESTER VIII

Course Code	Category	Course Name	Credits				Hours			
			L	T	P	C	L	T	P	Total
XEC801	PE	Professional Elective-5*	3	0	0	3	3	0	0	3
XOE802	OE	Open Elective - 4**	3	0	0	3	3	0	0	3
XOE803	OE	Open Elective - 5**	3	0	0	3	3	0	0	3
XEC804	Project	Project Work Phase – II	0	0	12	6	0	0	16	16
		Total	9	0	12	**15**	9	0	16	25

Total Credits - 15

*** Professional Elective** **** Open Elective** ***# Non-credit Course**

Grant Total Credits: 157

In Plant Training of 30 days in the vacation periods is mandatory to complete the graduation.

LIST OF ELECTIVES

Program Elective PE	CODE NO.	COURSE TITLE	L	T	P	C
PE1	XEC505A	Medical Electronics	3	0	0	3
505*	XEC505B	Communication Networks	3	0	0	3
	XEC505C	Nano Technology and Applications	3	0	0	3
PE2	XEC604A	Switching Theory	3	0	0	3
604*	XEC604B	CMOS Analog IC Design	3	0	0	3
	XEC604C	Statistical Theory of Communication	3	0	0	3
PE3	XEC702A	Fundamentals of Data structures in C	3	0	0	3
702*	XEC702B	Robotics and Automation	3	0	0	3
	XEC702C	Internet of things	3	0	0	3
PE4	XEC703A	Wireless Communications	3	0	0	3
703*	XEC703B	Wireless Networks	3	0	0	3
	XEC703C	Ad hoc and Wireless Sensor Networks	3	0	0	3
PE5	XEC801A	Principles of Speech Processing	3	0	0	3
801*	XEC801B	Multimedia Compression and Communication	3	0	0	3
	XEC801C	Digital Image Processing	3	0	0	3

COURSE CODE			**XMA101**	**L**	**T**	**P**	**C**
COURSE NAME			**CALCULUS AND LINEAR ALGEBRA**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0.5**	**0.5**		**3**	**1**	**0**	**4**

PREREQUISITE: Differentiation and Integration

Course Outcomes		**Domain**	**Level**
CO1	**Apply** orthogonal transformation to reduce quadratic form to canonical forms.	Cognitive	Remembering Applying
CO2	**Apply** power series to tests the convergence of the sequences and series. Half range Fourier sine and cosine series.	Cognitive Psychomotor	Applying Remembering Guided Response
CO3	**Find** the derivative of composite functions and implicit functions. Euler's theorem and Jacobian	Cognitive Psychomotor	Remembering Guided Response
CO4	**Explain** the functions of two variables by Taylors expansion, by finding maxima and minima with and without constraints using Lagrangian Method. Directional derivatives, Gradient, Curl and Divergence.	Cognitive Affective	Remembering Understanding Receiving
CO5	**Apply** Differential and Integral calculus to notions of Curvature and to improper integrals.	Cognitive	Applying

UNIT I - MATRICES	**15 Hours**
Linear Transformation - Eigen values and Eigen vectors -Properties of Eigen values and Eigen vectors - Cayley-Hamilton Theorem – Diagonalisation of Matrices – Real Matrices: Symmetric - Skew-Symmetric and Orthogonal Quadratic form – canonical form - Nature of Quadratic form and Transformation of Quadratic form to Canonical form (Orthogonal only).	
UNIT 2 - SEQUENCES AND SERIES	**15 Hours**
Sequences: Definition and examples-Series: Types and convergence- Series of positive terms – Tests of convergence: comparison test, Integral test and D'Alembert's ratio test-. Fourier series: Half range sine and cosine series- Parseval's Theorem.	
UNIT 3 - MULTIVARIABLE CALCULUS: PARTIAL DIFFERENTIATION	**15 Hours**

Limits and continuity –Partial differentiation – Total Derivative – Partial differentiation of Composite Functions: Change of Variables – Differentiation of an Implicit Function - Euler's Theorem- Jacobian.

UNIT 4 - MULTIVARIABLE CALCULUS: MAXIMA AND MINIMA AND VECTOR CALCULUS	15 Hours
Taylor's theorem for function of Two variables- Maxima, Minima of functions of two variables: with and without constraints - Lagrange's Method of Undetermined Multipliers – Directional Derivatives - Gradient, Divergence and Curl.	
UNIT 5 - DIFFERENTIAL AND INTEGRAL CALCULUS	**15 Hours**
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	

	LECTURE	TUTORIAL	TOTAL
	60	15	75

TEXT BOOKS

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2015**. (Unit-1, Unit-3 and Unit-4).**
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2014. **(Unit-2).**
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2010. **(Unit-5).**

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

Table 1: Mapping of Cos with GAs:

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA1 0	GA1 1	GA1 2
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE	XCP102	L	T	P	C
COURSE NAME	PROGRAMMING FOR PROBLEM SOLVING	3	0	2	5
PREREQUISITES		L	T	P	H
C:P:A		3	0	4	7

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Define*** programming fundamentals and ***Solve*** simple programs using I/O statements	Cognitive Psychomotor	Remember Understand Apply
CO2	***Define*** syntax and ***write simple programs*** using control structures and arrays	Cognitive Psychomotor	Remember Understand Apply
CO3	***Explain*** and ***write simple programs*** using functions and pointers	Cognitive Psychomotor	Understand Apply
CO4	***Explain*** and ***write simple programs*** using structures and unions	Cognitive Psychomotor	Understand Apply Analyze
CO5	***Explain*** and ***write simple programs*** using files and ***Build*** simple projects	Cognitive Psychomotor	Remember Understand Create

UNIT I - PROGRAMMING FUNDAMENTALS AND INPUT / OUTPUT STATEMENTS — **9+6 Hours**

Theory

Introduction to components of a computer system, Program – Flowchart – Pseudo code – Software – Introduction to C language – Character set – Tokens: Identifiers, Keywords, Constants, and Operators – sample program structure -Header files – Data Types-Variables - Output statements – Input statements. **Practical**

1. Program to display a simple picture using dots.
2. Program for addition of two numbers
3. Program to swap two numbers
4. Program to solve any mathematical formula.

UNIT II - CONTROL STRUCTURE AND ARRAYS — **9+6 Hours**

Theory

Control Structures – Conditional Control statements: Branching, Looping -Unconditional control structures: switch, break, continue, goto statements – Arrays: One Dimensional Array – Declaration – Initialization – Accessing Array Elements – Searching – Sorting – Two Dimensional arrays - Declaration – Initialization – Matrix Operations – Multi Dimensional Arrays - Declaration – Initialization. Storage classes: auto – extern – static. Strings: Basic operations on strings.

Practical

1. Program to find greatest of 3 numbers using Branching Statements
2. Program to display divisible numbers between n1 and n2 using looping Statement
3. Program to remove duplicate element in an array.
4. Program to perform string operations.

5. Performing basic sorting algorithms.

UNIT III - FUNCTIONS AND POINTERS	9+6 Hours

Theory

Functions: Built in functions – User Defined Functions - Parameter passing methods - Passing arrays to functions – Recursion - Programs using arrays and functions. Pointers - Pointer declaration - Address operator - Pointer expressions & pointer arithmetic - Pointers and function - Call by value - Call by Reference - Pointer to arrays - Use of Pointers in self-referential structures-Notion of linked list(no implementation).

Practical

1. Program to find factorial of a given number using four function types.
2. Programs using Recursion such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort
3. Programs using Pointers

UNIT IV - STRUCTURES AND UNIONS	9+6 Hours

Theory

Structures and Unions - Giving values to members - Initializing structure -Functions and structures - Passing structure to elements to functions - Passing entire function to functions - Arrays of structure - Structure within a structure and Union.

Practical

1. Program to read and display student mark sheet Structures with variables
2. Program to read and display student marks of a class using Structures with arrays
3. Program to create linked list using Structures with pointers

UNIT V - FILES	9+6 Hours

Theory

File management in C - File operation functions in C - Defining and opening a file - Closing a file - The getw and putw functions - The fprintf & fscanf functions - fseek function – Files and Structures.

Practical

1. Program for copying contents of one file to another file.
2. Program using files using structure with pointer

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	30	75

TEXT BOOKS/ REFERENCES

1. Byron Gottfried, "Programming with C", III Edition, (Indian Adapted Edition), TMH publications, 2010
2. Yeshwant Kanethker, “Let us C”, BPB Publications, 2008.
3. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc. 2005.
4. Behrouz A. Forouzan and Richard. F. Gilberg, "A Structured Programming Approach Using C", II Edition, Brooks–Cole Thomson Learning Publications, 2001
5. Johnson baugh R. and Kalin M., “Applications Programming in ANSI C”, III Edition, Pearson Education India, 2003.
6. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

Table 1: COs Versus POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			3						2	3	2	
CO2	3	2			2						2	3	2	
CO3	2	2	1	2	2						2	2	2	
CO4	2	2	1	2	2						2	2	2	
CO5	2	2	1		2			1		2	2	2	2	
Total	**12**	**10**	**3**	**4**	**11**			**1**		**2**	**10**	**12**	**10**	
Scaled Value	3	2	1	1	3			**1**		1	2	3	2	

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

COURSE CODE			XGS103	L	T	P	C
COURSE NAME			ENGLISH	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
2.6	0.4	0					

COURSE OUTCOMES:		Domain	Level
CO1	***Ability*** to recall the meaning for proper usage	Cognitive	Remember
CO2	***Apply*** the techniques in sentence patterns	Cognitive	Apply
CO3	***Identify*** the common errors in sentences	Cognitive	Remember
CO4	***Construct*** the Nature and Style of sensible Writing	Cognitive	Create
CO5	***Practicing*** the writing skills	Psychomotor	Guided Response
CO6	***Grasping*** the techniques in learning sounds and etiquettes	Psychomotor	Adapting

UNIT I - VOCABULARY BUILDING	**9 Hours**

1.1 The concept of Word Formation

1.2 Root words from foreign languages and their use in English

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

1.4 Synonyms, antonyms, and standard abbreviations.

UNIT II - BASIC WRITING SKILLS	**9 Hours**

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

UNIT III - IDENTIFYING COMMON ERRORS IN WRITING	**9 Hours**

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

UNIT IV - NATURE AND STYLE OF SENSIBLE WRITING	9 Hours

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

UNIT V - WRITING PRACTICES	9 Hours

5.1 Comprehension
5.2 Précis Writing
5.3 Essay Writing

UNIT VI - ORAL COMMUNICATION

(This unit involves interactive practice sessions in Language Lab)

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

Suggested Readings:

(i) Practical English Usage. Michael Swan. OUP. 1995
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii) On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006
(v) Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Table 1: Mapping of Cos with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO2	2	0	0	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	0	0	0	0	1	0	1	0	0	0	0	0
CO4	2	0	0	0	0	0	1	0	1	0	0	0	0	0
CO5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7	0	0	0	0	0	6	0	4	0	0	0	0	0
Scaled Value	2	0	0	0	0	0	2	0	1	0	0	0	0	0
	1	0	0	0	0	0	1	0	1	0	0	0	0	0

1-5= 1, 6-10 = 2, 11-15= 3

0-No Relation, 1- Low Relation, 2 - Medium Relation, 3- High

COURSE CODE			XAC104	L	T	P	C
COURSE NAME			APPLIED CHEMISTRY FOR ENGINEERS	3	1	1	5
PREREQUISITES			Nil	L	T	P	H
C	P	A		3	1	2	6
3.5	1.0	0.5					

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Identify*** the periodic properties such as ionization energy, electron affinity, oxidation states and electro negativity. ***Describe*** the various water quality parameters like hardness and alkalinity.	Cognitive Psychomotor	Remember Perception
CO2	***Explain*** *and* ***Measure*** microscopic chemistry in terms of atomic, molecular orbitals and intermolecular forces.	Cognitive Psychomotor	Understand Set
CO3	***Interpret*** bulk properties and processes using thermodynamic and kinetic considerations.	Cognitive Psychomotor Affective	Apply Mechanism Receive
CO4	***Describe, Illustrate*** *and* ***Discuss*** the chemical reactions that are used in the synthesis of molecules.	Cognitive Psychomotor Affective	Remember Analyze Perception Respond
CO5	***Apply, Measure*** and ***Distinguish*** the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	Cognitive Psychomotor	Remember Apply Mechanism

UNIT I - PERIODIC PROPERTIES AND WATER CHEMISTRY **8+3+6**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries. **Water Chemistry**-Water quality parameters-Definition and explanation of hardness, determination of hardness by EDTA method· Introduction to alkalinity.

UNIT II - USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA **12+3+6**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base oxidation reduction and solubility equilibria. Corrosion-Types, factors affecting corrosion rate and Control methods. Use of free energy considerations in metallurgy through Ellingham diagrams. Advantages of electroless plating, electroless plating of nickel and copper on Printed Circuit Board (PCB).

UNIT III - ATOMIC AND MOLECULAR STRUCTURE	10+3+6

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles.. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic molecules. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Intermolecular forces and potential energy surfaces

Ionic, dipolar and Vander waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

UNIT IV - SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	7+3+6

Principles of spectroscopy and selection rules. Electronic spectroscopy - chromophore, auxochromes, types of electronic transition and application. Fluorescence and its applications in medicine. Vibrational spectroscopy-types of vibrations, Instrumentation and applications. Rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance spectroscopy-concept of chemical shift and applications-magnetic resonance imaging. Diffraction and scattering.

UNIT V - STEREOCHEMISTRY AND ORGANIC REACTIONS	8+3+6

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization reactions and ring opening reactions. Synthesis of a commonly used drug molecule-Aspirin and paracetamol.

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

TEXT BOOKS

1. Puri B.R. Sharma, L.R., Kalia K.K. Principles of Inorganic Chemistry, (23rd ition), New Delhi, Shoban Lal Nagin Chand & Co., 1993
2. Lee. J.D. Concise Inorganic Chemistry, UK, Black well science, 2006.
3. Trapp. C, Cady, M. Giunta. C, Atkins's Physical Chemistry, 10th Edition, Oxford publishers, 2014.
4. Glasstone S., Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co. Ltd, 1983.
5. Morrison R.T. and Boyd R.N. Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., 1976.
6. Banwell. C.N, Fundamentals of Molecular Spectroscopy, (3th Edition), McGraw-Hill Book Company, Europe 1983.
7. Bahl B.S. and Arun Bahl, Advanced Organic Chemistry, (4th edition), S./ Chand & Company Ltd. New Delhi, 1977.
8. P. S. Kalsi, Stereochemistry: Conformation and mechanism, (9th Edition), New Age International Publishers, 2017.

REFERENCE BOOKS

1. Puri B R Sharma L R and Madan S Pathania, " Principles of Physical Chemistry", Vishal publishing Co., Edition 2004
2. Kuriocose, J C and Rajaram, J, "Engineering Chemistry", Volume I/II, Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2000

E Resources - MOOCs:

1. http://www.mooc-list.com/course/chemistry-minor-saylororg
2. https://www.canvas.net/courses/exploring-chemistry
3. http://freevideolectures.com/Course/2263/Engineering-Chemistry-I
4. http://freevideolectures.com/Course/3001/Chemistry-I
5. http://freevideolectures.com/Course/3167/Chemistry-II
6. http://ocw.mit.edu/courses/chemistry/

Laboratory Part **30 hrs**

Experiments :	
1. Determination of chloride ion present in the water sample by Argentometric method.	**CO1**
2. Determination of total, temporary and permanent hardness of water sample by EDTA method.	**CO1**
3. Determination of cell constant and conductance of solutions.	**CO2**
4. Potentiometry - determination of redox potentials and emfs.	**CO2**
5. Determination of surface tension and viscosity.	**CO3**
6. Adsorption of acetic acid by charcoal.	**CO3**
7. Determination of the rate constant of a reaction.	**CO4**
8. Estimation of iron by colorimetric method.	**CO4**
9. Synthesis of a polymer/drug.	**CO5**
10. Saponification/acid value of an oil.	**CO5**

REFERENCE BOOKS

1. Mendham, Denney R.C,. Barnes J.D and Thomas N.J.K., "Vogel's Textbook of Quantitative Chemical Analysis", 6th Edition, Pearson Education, 2004.
2. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. "Experiments in Physical Chemistry", 8th Ed.; McGraw-Hill: New York, 2003.

E Resources - MOOCs:

1.http://freevideolectures.com/Course/2380/Chemistry-Laboratory-Techniques
2. http://freevideolectures.com/Course/2941/Chemistry-1A-General-Chemistry-Fall-2011
3.http://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques

Table 1 : Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	0	0	0	0	0	2	3	3
CO2	2	0	0	0	0	0	1	2	2
CO3	3	0	0	0	0	0	2	3	3
CO4	8	0	0	0	0	0	3	3	3
CO5	3	0	0	0	0	0	2	2	3

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

SUB CODE			XWP105	L	T	P	C
SUB NAME			WORKSHOP PRACTICES	1	0	2	3
C	P	A		L	T	P	H
1	2	0		1	0	4	5

PREREQUISITE:

	Course outcomes	Domain	Level
CO1	***Summarize*** the machining methods and ***Practice*** machining operation.	Cognitive Psychomotor	Understanding Guided response
CO2	***Defining*** metal casting process, moulding methods and **relates** Casting and Smithy applications.	Cognitive Psychomotor	Remembering Perception
CO3	***Plan*** basic carpentry and fitting operation and ***Practice*** carpentry and fitting operations.	Cognitive Psychomotor	Applying Guided response
CO4	***Summarize*** metal joining operation and ***Practice*** welding operation.	Cognitive Psychomotor	Understanding Guided response
CO5	***Illustrate*** the, electrical and electronics basics and ***Makes*** appropriate connections**.**	Cognitive Psychomotor	Understanding Origination

COURSE CONTENT

EXP. NO	TITLE	CO RELATION
1	Introduction to Machining Process	CO1
2	Plain Turining using Lathe Operation	CO1
3	Introduction to CNC	CO1
4	Demonstration of Plain Turning using CNC	CO1
5	Study of Metal Casting Operation	CO2
6	Demonstration of Molding Process	CO2
7	Study of Smithy Operation	CO2
8	Study of Carpentry Tools	CO3
9	Half lap joint – Carpentry	CO3
10	Mortise and Tenon joint – Carpentry	CO3
11	Study of fitting tools	CO3
12	Square fitting	CO3
13	Triangular fitting	CO3
14	Study of Welding Tools	CO4
15	Square butt joint - welding	CO4
16	Tee joint – Welding	CO4
17	Introduction to house wiring	CO5
18	One lamp controlled by one switch	CO5
19	Two lamps controlled by single switch	CO5
20	Staircase wiring	CO5

TEXT BOOKS

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.

REFERENCES

1. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
2. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
3. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
4. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

E RESOURCES

1. **http://nptel.ac.in/courses/112107145/**

Mapping of CO's with PO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	1			1	1		1	2
CO2	2	1	2	2	1			1	1		1	2
CO3	2	1	2	2	1			1	1		1	2
CO4	2	1	2	2	1			1	1		1	2
CO5	2	1	2	2	1			1	1		1	2
Total												
Scaled												

0- No relation 1- Low relation 2- Medium relation 3- High relation

COURSE CODE			XMA201	L	T	P	C
COURSE NAME			CALCULUS, ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLE	3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		3	1	0	4

PREREQUISITE: Mathematics I (Calculus and Linear Algebra)

Course Outcomes		Domain	Level
CO1	**Find** double and triple integrals and to find line, surface and volume of an integral by **Applying** Greens, Gauss divergence and Stokes theorem.	Cognitive	Applying Remembering
CO2	**Solve** first order differential equations of different types which are solvable for p, y, x and Clairaut's type.	Cognitive	Applying
CO3	**Solve** Second order ordinary differential equations with variable coefficients using various methods.	Cognitive	Applying
CO4	**Use** CR equations to verify analytic functions and to find harmonic functions and harmonic conjugate. Conformal mapping of translation and rotation. Mobius transformation.	Cognitive Psychomotor	Remembering Applying Guided Response
CO5	**Apply** Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem. Taylor's series, zeros of analytic functions, singularities, Laurent's series.	Cognitive Affective	Applying Receiving

UNIT - I MULTIVARIABLE CALCULUS (Integration)	**12 Hours**

Multiple Integration: Double integrals (Cartesian) - change of order of integration in double integrals - Change of variables (Cartesian to polar) - Triple integrals (Cartesian), Scalar line integrals - vector line integrals - scalar surface integrals - vector surface integrals - Theorems of Green, Gauss and Stokes.

UNIT - II FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	**12 Hours**

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

UNIT - III ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS	**12 Hours**

Second order linear differential equations with variable coefficients- method of variation of parameters - Cauchy-Euler equation- Power series solutions- Legendre polynomials- Bessel functions of the first kind and their properties.

UNIT - IV COMPLEX VARIABLE – DIFFERENTIATION	**12 Hours**

Differentiation-Cauchy-Riemann equations- analytic functions-harmonic functions-finding harmonic conjugate- elementary analytic functions (exponential, trigonometric, logarithm) and their properties- Conformal mappings- Mobius transformations and their properties.

UNIT - V COMPLEX VARIABLE - INTEGRATION	**12 Hours**

Contour integrals - Cauchy-Goursat theorem (without proof) - Cauchy Integral formula (without proof)-Liouville's theorem (without proof)- Taylor's series- zeros of analytic functions-singularities- Laurent's series – Residues- Cauchy Residue theorem (without proof)- Evaluation of definite integral involving sine and cosine- Evaluation of certain improper integrals using the Bromwich contour.

HOURS	**LECTURE**	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

TEXT BOOK

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40thth Edition, 2008.

REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdn. Wiley India, 2009.
4. S. L. Ross, "Differential Equations", 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
6. E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7th Ed., McGraw Hill, 2004.
8. N. P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

Table 1: Mapping of Cos with GAs:

	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA1 0	GA1 1	GA1 2
CO 1	3	2			2					1		2
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	2								1		1
CO 5	3	2			1					1		2
	15	8	0	0	3	0	0	0	0	5	0	7
Scaled Value	3	2			1					1		

$1 – 5 \rightarrow 1$, $6 – 10 \rightarrow 2$, $11 – 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE			XES202	L	T	P	C
COURSE NAME			ENVIRONMENTAL SCIENCES	0	0	0	0
PREREQUISITE				L	T	P	H
C	P	A		3	0	0	3
1.4	0.3	0.3					

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** the significance of natural resources and ***explain*** anthropogenic impacts.	Cognitive	Remember Understand
CO2	***Illustrate*** the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive	Understand
CO3	***Identify*** the facts, consequences, preventive measures of major pollutions and ***recognize*** the disaster phenomenon	Cognitive Affective	Remember Receive
CO4	***Explain*** the socio-economic, policy dynamics and ***practice*** the control measures of global issues for sustainable development.	Cognitive	Understand Apply
CO5	***Recognize*** the impact of population and the concept of various welfare programs, and ***apply*** the modern technology towards environmental protection.	Cognitive	Understand Analysis

UNIT - I INTRODUCTION TO ENVIRONMENTAL STUDIES AND ENERGY — **12 Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams-benefits and problems – Mineral resources: Uses, environmental effects of mining, case studies-iron mining(Goa), bauxite mining(Odisha) – Food resources: effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource, land degradation – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

UNIT - II ECOSYSTEMS AND BIODIVERSITY — **7 Hours**

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Biogeochemical cycles – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT - III ENVIRONMENTAL POLLUTION — **10 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards

– Solid waste management– Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT	**10 Hours**

Rain water harvesting – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT - V HUMAN POPULATION AND THE ENVIRONMENT	**6 Hours**

Population growth, variation among nations – Population explosion– Environment and human health – HIV / AIDS– Role of Information Technology in Environment and human health.

HOURS	**LECTURE**	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	45	**0**	**0**	**45**

TEXT BOOKS

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, 2000.
2. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, 2003
3. Trivedi R.K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, 2003.
4. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, 2006.
5. Introduction to International disaster management, Butterworth Heinemann, 2006.
6. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, 2004.

REFERENCE BOOKS

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, 2009.
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, 2012.
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, 2003.
5. Sundar, Disaster Management, Sarup & Sons, New Delhi, 2007.
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, 2006.

E – RESOURCES

1. http://www.e-booksdirectory.com/details.php?ebook=10526
2. https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science
3. https://www.free-ebooks.net/ebook/What-is-Biodiversity
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. http://bookboon.com/en/pollution-prevention-and-control-ebook
6. http://www.e-booksdirectory.com/details.php?ebook=8557
7. http://www.e-booksdirectory.com/details.php?ebook=6804
8. http://bookboon.com/en/atmospheric-pollution-ebook
9. http://www.e-booksdirectory.com/details.php?ebook=3749
10. http://www.e-booksdirectory.com/details.php?ebook=2604
11. http://www.e-booksdirectory.com/details.php?ebook=2116
12. http://www.e-booksdirectory.com/details.php?ebook=1026
13. http://www.faadooengineers.com/threads/7894-Environmental-Science

COURSE CODE			XBE203	L	T	P	C
COURSE NAME			ELECTRICAL AND ELECTRONICS ENGINEERING SYSTEMS	3	1	1	5
PREREQUISITES			Physics	L	T	P	H
C	P	A		3	1	2	6
3	1	0					

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Define, Relate,*** the fundamentals of electrical parameters and***build*** and ***explain***AC, DC circuits by Using measuring devices	Cognitive Psychomotor	Remember Understand Mechanism set
CO2	***Define and Explain*** the of operation of DCand AC machines.	Cognitive	Remember Understand
CO3	***Recall, Illustrate,***varioussemiconductor Devices and their applications and displays the input output characteristics of basic semiconductor devices.	Cognitive Psychomotor	Remember Understand Mechanism
CO4	***Relate Explain,*** the number systems and logic gates. ***Construc***t the different digital circuit.	Cognitive Psychomotor	Remember Understand Orgination
CO5	***Label, Outline*** different types of microprocessors and their applications.	Cognitive	Remember Understand

UNIT - I FUNDAMENTAL OF DC AND AC CIRCUITS, MEASUREMENTS	**9+6+12**

Fundamentals of DC– Ohm's Law – Kirchoff's Laws - Sources - Voltage and Current relations –Star/Delta Transformation - Fundamentals of AC – Average Value, RMS Value, Form Factor - AC power and Power Factor, Phasor Representation of sinusoidal quantities - Simple Series, Parallel, Series Parallel Circuit - Operating Principles of Moving coil and Moving Iron Instruments (Ammeter, Voltmeter) and Dynamometer type meters (Watt meter and Energy meter).

UNIT - II ELECTRICAL MACHINES	**9 + 3+0**

Construction, Principle of Operation, Basic Equations, Types and Application of DC Generators, DC motors - Basics of Single Phase Induction Motor and Three Phase Induction Motor- Construction, Principle of Operation of Single Phase Transformer, Three phase transformers, Auto transformer.

UNIT - III SEMICONDUCTOR DEVICES	**9 + 0+8**

Classification of Semiconductors, Construction, Operation and Characteristics: PN Junction Diode – Zener Diode, PNP, NPN Transistors, Field Effect Transistors and Silicon Controlled Rectifier – Applications.

UNIT - IV DIGITAL ELECTRONICS	9 + 3+10
Basic of Concepts of Number Systems, Logic Gates, Boolean Algebra, Adders, Subractors, multiplexer, demultiplexer, encoder, decoder, Flipflops, Up/Down counters, Shift Registers.	
UNIT - V MICROPROCESSORS	**9+ 3+0**
Architecture, 8085, 8086 - Interfacing Basics: Data transfer concepts – Simple Programming concepts.	

LIST OF EXPERIMENTS :

1.	Study of Electrical Symbols, Tools and Safety Precautions, Power Supplies.
2.	Study of Active and Passive elements – Resistors, Inductors and Capacitors, Bread Board.
3.	Verification of AC Voltage, Current and Power in Series and Parallel connection.
4.	Testing of DC Voltage and Current in series and parallel resistors which are connected in breadboard by using Voltmeter, Ammeter and Multimeter.
5.	Fluorescent lamp connection with choke.
6.	Staircase Wiring.
7.	Forward and Reverse bias characteristics of PN junction diode.
8.	Forward and Reverse bias characteristics of zener diode.
9.	Input and Output Characteristics of NPN transistor.
10.	Construction and verification of simple Logic Gates.
11.	Construction and verification of adders.
12.	Construction and verification of subtractor.

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

TEXT BOOKS

1. Metha V.K., 2008. Principles of Electronics. Chand and Company.
2. Malvino, A. P., 2006. Electronics Principles. 7th ed. New Delhi: Tata McGraw-Hill.
3. Rajakamal, 2007. Digital System-Principle & Design. 2nd ed. Pearson education.
4. Morris Mano, 1999. Digital Design. Prentice Hall of India.
5. Ramesh, S. Gaonkar, 2000. Microprocessor Architecture, Programming and its Applications with the 8085. 4th ed. India: Penram International Publications.

REFERENCE BOOKS

1. Corton,H.,2004. Electrical Technology. CBS Publishers & Distributors.
2. Syed, A. Nasar, 1998, Electrical Circuits. Schaum Series.
3. Jacob Millman and Christos, C. Halkias, 1967. Electronics Devices.New Delhi: McGraw-Hill.
4. Millman, J. andHalkias, C. C., 1972. Integrated Electronics: Analog and Digital Circuits and Systems. Tokyo: McGraw-Hill, Kogakusha Ltd.

5. Mohammed Rafiquzzaman, 1999. Microprocessors - Theory and Applications: Intel and Motorola. Prentice Hall International.

E-REFERENCES

1. NTPEL, Basic Electrical Technology (Web Course), Prof. N. K. De, Prof. T. K. Bhattacharya and Prof. G. D. Roy, IIT Kharagpur.
2. Prof.L.Umanand, http://freevideolectures.com/Course/2335/Basic-Electrical-Technology#, IISc Bangalore.
3. http://nptel.ac.in/Onlinecourses/Nagendra/, Dr. Nagendra Krishnapura , IIT Madras.
4. Dr.LUmanand , http://www.nptelvideos.in/2012/11/basic-electrical-technology.html, IISC Bangalore

Table: 1 Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	1			1	1	1			
CO 2	3	3	1	1	1	1			1	1	1			
CO 3	2	2	2	1	2	2	1	1	1	1	1			
CO 4	2	2	1	1	1	1	1	1	1	1	1			
CO 5	2	2	1	1	1	1	1	1	1	1	1			
Total	12	12	6	5	6	6	3	3	5	5	5			
Scaled value	3	3	2	1	2	2	1	1	1	1	1			

1-5 → 1, 6-10 → 2, 11-15 → 3

0 – No relation, 1 – Low relation, 2 – Medium relation, 3 – High relation

COURSE CODE			XAP204	L	T	P	C
COURSE NAME			APPLIED PHYSICS FOR ENGINEERS	3	1	2	6
PREREQUISITE			Basic Physics in HSC level	L	T	P	H
C	P	A		3	1	3	7
2.8	0.8	0.4					

COURSE OUTCOMES		Domain	Level
CO1	***Identify*** the basics of mechanics, ***explain*** the principles of elasticity and ***determine*** its significance in engineering systems and technological advances.	Cognitive Psychomotor	Remember, Understand Mechanism
CO2	***Illustrate*** the laws of electrostatics, magneto-statics and electromagnetic induction; ***use*** and ***locate*** basic applications of electromagnetic induction to technology.	Cognitive Psychomotor Affective	Remember, Analyze, Mechanism Respond
CO3	***Understand*** the fundamental phenomena in optics by measurement and ***describe*** the working principle and application of various lasers and fibre optics.	Cognitive Psychomotor Affective	Understand, Apply Mechanism Receive
CO4	***Analyse*** energy bands in solids, ***discuss*** and ***use*** physics principles of latest technology using semiconductor devices.	Cognitive Psychomotor Affective	Understand, Analyze Mechanism Receive
CO5	***Develop*** Knowledge on particle duality and ***solve*** Schrodinger equation for simple potential.	Cognitive:	Understand, Apply

UNIT - I MECHANICS OF SOLIDS **9+3+9**

Mechanics: Force - Newton's laws of motion - work and energy - impulse and momentum - torque - law of conservation of energy and momentum - Friction.
Elasticity: Stress - Strain - Hooke's law - Stress strain diagram - Classification of elastic modulus - Moment, couple and torque - Torsion pendulum - Applications of torsion pendulum - Bending of beams - Experimental determination of Young's modulus: Uniform bending and non-uniform bending.

UNIT - II ELECTROMAGNETIC THEORY **9+3+3**

Laws of electrostatics - Electrostatic field and potential of a dipole; Dielectric Polarisation, Dielectric constant, internal field - Clausius Mossotti Equation - Laws of magnetism - Ampere's Faraday's law; Lenz's law - Maxwell's equation - Plane electromagnetic waves; their transverse nature - expression for plane, circularly and elliptically polarized light - quarter and half wave plates - production and detection of plane, circularly and elliptically polarized light.

UNIT –III OPTICS, LASERS AND FIBRE OPTICS **9+3+12**

Optics: Dispersion- Optical instrument: Spectrometer - Determination of refractive index and dispersive power of a prism- Interference of light in thin films: air wedge - Diffraction: grating.
LASER: Introduction - Population inversion -Pumping - Laser action - Nd-YAG laser - CO_2 laser - Applications
Fibre Optics: Principle and propagation of light in optical fibre - Numerical aperture and acceptance angle - Types of optical fibre - Fibre optic communication system (Block diagram).

UNIT - IV SEMICONDUCTOR PHYSICS	9+3+6

Semiconductors: Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Intrinsic semiconductors - Concept of holes - doping - Extrinsic semiconductors - P type and N type semiconductors - Hall effect.
Diodes and Transistors: P-N junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave rectifier using P N junction diodes - PNP and NPN transistors - Three different configurations - Advantages of common emitter configuration - working of NPN transistor as an amplifier in common emitter configuration.

UNIT -V QUANTUM PHYSICS	9+3+0

Introduction to quantum physics, black body radiation, Compton effect, de Broglie hypothesis, wave – particle duality, uncertainty principle, Schrodinger wave equation (Time dependent and Time independent), particle in a box, Extension to three dimension - Degeneracy.

TEXT BOOKS

1. Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai Publications, 2009.
2. Avadhanulu M. N. "Engineering Physics" (Volume I and II), S. Chand & Company Ltd., New Delhi, 2010.

REFERENCE BOOKS

1. Palanisamy P. K., "Engineering Physics", Scitech Publications (India) Pvt. Ltd, Chennai.
2. Arumugam M., "Engineering Physics" (Volume I and II), Anuradha Publishers, 2010.
3. Senthil Kumar G., " Engineering Physics", 2nd Enlarged Revised Edition, VRB Publishers, Chennai, 2011.
4. Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.

E RESOURCES

1. NPTEL , Engineering Physics, Prof. M. K. Srivastava, Department of Physics, IIT, Roorkee.

LABORATORY

1.	Torsional Pendulum - determination of moment of inertia and rigidity modulus of the given material of the wire.
2.	Uniform Bending - Determination of the Young's Modulus of the material of the beam.
3.	Non-Uniform Bending - Determination of the Young's Modulus of the material of the beam.
4.	Meter Bridge - Determination of specific resistance of the material of the wire.
5.	Spectrometer - Determination of dispersive power of the give prism.
6.	Spectrometer - Determination of wavelength of various colours in Hg source using grating.
7.	Air wedge - Determination of thickness of a given thin wire.
8.	Laser - Determination of wavelength of given laser source and size of the given micro particle using Laser grating.
9.	Post office Box - Determination of band gap of a given semiconductor.

10.	PN Junction Diode - Determination of V-I characteristics of the given diode.

REFERENCE BOOKS

1. Samir Kumar Ghosh, "A text book of Advanced Practical Physics", New Central Agency (P) Ltd, 2008.
2. Arora C.L., "Practical Physics", S. Chand & Company Ltd., New Delhi, 2013.
3. Umayal Sundari AR., "Applied Physics Laboratory Manual", PMU Press, Thanjavur, 2012.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	15	30	90

Table 1: Mapping of CO's with PO:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS1	PS2
CO1	3	2	2	2	1	-	-	-	1	-	-	1		
CO2	3		1		1	-	-	-		-	-	1		
CO3	3	2	2	2	1	-	-	-	1	-	-	1		
CO4	3	2	2	2	1	-	-	-	1	-	-	1		
CO5	3		2			-	-	-		-	-	1		
Total	**15**	**6**	**9**	**6**	**4**				**3**			**5**		
Scaled to 0,1,2,3 scale	**3**	**2**	**2**	**2**	**1**				**1**			**1**		

1 – 5 →1, 6 – 10→ 2, 11 – 15→ 3

0-No Relation, 1- Low Relation, 2-Medium Relation, 3-High Relation

SUB CODE			XEG205	L	T	P	C
SUB NAME			ENGINEERING GRAPHICS AND DESIGN	2	0	1	3
C	P	A		L	T	P	H
1.75	1	0.25		2	0	2	4

PREREQUISITE: NIL

Course outcomes:		Domain	Level
CO1	*Apply* the national and international standards, *construct* and *practice* various curves	Cognitive, Psychomotor and Affective	Applying, Guided response and Responds to Phenomena
CO2	*Interpret*, *construct* and *practice* orthographic projections of points, straight lines and planes.	Cognitive, Psychomotor and Affective	Understanding, Mechanism and Responds to Phenomena
CO3	*Construct Sketch* and *Practice* projection of solids in various positions and true shape of sectioned solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena
CO4	*Interpret*, *Sketch* and *Practice* the development of lateral surfaces of simple and truncated solids, intersection of solids.	Cognitive, Psychomotor and Affective	Understanding, Complex Overt Response and Responds to Phenomena
CO5	*Construct sketch* and *practice* isometric and perspective views of simple and truncated solids.	Cognitive, Psychomotor and Affective	Applying, Complex Overt Response and Responds to Phenomena

UNIT - I INTRODUCTION, FREE HAND SKETCHING OF ENGG OBJECTS AND CONSTRUCTION OF PLANE CURVE **12+6**

Importance of graphics in engineering applications – use of drafting instruments – BIS specifications and conventions as per SP 46-2003.

Pictorial representation of engineering objects – representation of three dimensional objects in two dimensional media – need for multiple views – developing visualization skills through free hand sketching of three dimensional objects.

Polygons & curves used in engineering practice – methods of construction – construction of ellipse, parabola and hyperbola by eccentricity method – cycloidal and involute curves – construction – drawing of tangents to the above curves. Practice on basic tools of CAD

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACES **12+6**

General principles of orthographic projection – first angle projection – layout of views – projections of points, straight lines located in the first quadrant – determination of true lengths of lines and their inclinations to the planes of projection – traces – projection of polygonal surfaces and circular lamina inclined to both the planes of projection-CAD practice on points and lines

UNIT - III PROJECTION OF SOLIDS AND SECTIONS OF SOLIDS	12+6
Projection of simple solids like prism, pyramid, cylinder and cone when the axis is inclined to one plane of projection – change of position & auxiliary projection methods – sectioning of above solids in simple vertical positions by cutting plane inclined to one reference plane and perpendicular to the other and above solids in inclined position with cutting planes parallel to one reference plane – true shapes of sections-CAD practice on solid models	
UNIT - IV DEVELOPMENT OF SURFACES AND INTERSECTION OF SOLIDS	**12+6**
Need for development of surfaces – development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones – development of lateral surfaces of the above solids with square and circular cutouts perpendicular to their axes – intersection of solids and curves of intersection –prism with cylinder, cylinder & cylinder, cone & cylinder with normal intersection of axes and with no offset-CAD practice on intersection of solids.	
UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS	**12+6**
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones – principles of perspective projections – projection of prisms, pyramids and cylinders by visual ray and vanishing point methods-CAD practice on isometric view	

	THEORY	PRACTICAL	TOTAL
	30	60	90

TEXT BOOKS

1. Bhatt,N.D, “Engineering Drawing”, Charotar Publishing House, 46th Edition-2003.
2. Natarajan,K.V, “ A Textbook of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006 .
3. Dr. P.K. Srividhya, P. Pandiyaraj, “Engineering Graphics”, PMU Publications, Vallam, 2013

REFERENCES

1. Luzadder and Duff, “Fundamentals of Engineering Drawing” Prentice Hall of India PvtLtd, XI Edition - 2001.
2. Venugopal,K. and Prabhu Raja, V., “Engineering Graphics”, New Age International(P) Ltd., 2008.
3. Gopalakrishnan.K.R,. “Engineering Drawing I & II”, Subhas Publications, 1998.
4. Shah,M.B and Rana,B.C.,”Engineering Drawing”, Pearson Education,2005.

E RESOURCES

1. http://periyarnet/Econtent
2. http://nptel.ac.in/courses/112103019/

Table 1: Mapping of CO's with PO'S:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	3	2	3	1	1	2	3	3	3	-
CO2	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO3	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO4	3	3	3	1	3	1	3	1	1	1	2	3	3	-
CO5	3	3	3	1	3	1	3	1	1	1	2	3	3	-
Total	15	15	15	6	15	6	15	5	5	6	11	3	3	-
Scaled	3	3	3	2	3	2	3	1	1	2	3	3	3	-

0 - No relation 1- Low relation 2- Medium relation 3- High relation

1-5 → 1, 6-10 → 2, 11-15 → 3

COURSE CODE			XMA301	L	T	P	C
COURSE NAME			TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	3	1	0	4
C	P	A		L	T	P	H
3	0.5	0.5		3	1	0	4
PREREQUISITE			Nil				

Learning Objectives

- Introduction of methods to solve linear partial differential equations of second order and higher order.
- Find the solutions of pde's are determined by conditions at the boundaries of the spatial domain and initial conditions at time zero.
- Provide sufficient knowledge to engineering students in the specific mathematical tools and techniques such as Fourier series, Fourier transform and Z transform.
- To enable students to use Fourier series method both in the solution of pde and other wider context.

COURSE OUTCOMES:

Course outcomes:		Domain	Level
CO1:	**Solve** standard types of first order and second order partial differential equations with constant coefficients. Elimination of arbitrary constants and functions.	Cognitive Psychomotor	Apply Imitation
CO2	***State*** Dirichlet's condition. **Explain** general Fourier series of the curve y = f(x) in the interval (0,2π) (-π, π), (0, 2 ℓ), (-ℓ,ℓ) and (0, π). Perform harmonic analysis	Cognitive Psychomotor	Remembering Understanding Imitation
CO3	***Solve*** the standard Partial Differential Equations, arising in engineering Problems, like one dimensional Wave equation and Heat flow equation by Fourier series method in Cartesian coordinates. Classify second order quasi pde.	Cognitive Affective	Apply Receiving
CO4	**Find** the Fourier transform and Fourier sine and cosine transforms of simple functions using definition and its properties.	Cognitive	Remembering Apply
CO5	***Apply*** the properties of Z transform to ***Find*** the Z transform and inverse Z transform of sequence and functions, and to solve the difference equation using them.	Cognitive	Remembering Apply

Unit - I PARTIAL DIFFERENTIAL EQUATIONS	12 Hours
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.	
Unit - II FOURIER SERIES	**12 Hours**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series –Parseval's identity – Harmonic Analysis.	
Unit - III APPLICATIONS OF BOUNDARY VALUE PROBLEMS	**12 Hours**
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates**.**	
Unit - IV FOURIER TRANSFORM	**12 Hours**
Fourier integral theorem (without proof) – Fourier transform pairs – Fourier Sine and Cosine transforms – properties – Transforms of simple functions – Convolution theorem – Parseval's identity.	
Unit - V Z TRANSFORM AND DIFFERENCE EQUATIONS	**12 Hours**
Z-transform – Elementary properties – Inverse Z – transform – Convolution theorem – Initial and Final value theorems - Formation of difference equations – Solution of difference equations. using Z-transform.	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi (2015).
2. Veerarajan. T., "Engineering Mathematics Volume III", Second reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.

REFERENCES

1. Churchill, R.V. and Brown, J.W., "Fourier Series and Boundary Value Problems", Fourth Edition, McGraw Hill Book Co., Singapore (1987).
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics Volume III", S. Chand & Company Ltd., New Delhi (1996).
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics" 7th Edition Lakshmi Publications (P) Limited, New Delhi (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Narayanan, S., ManicavachagomPillay, T.K. and Ramaniah, G., "Advanced Mathematics for Engineering Students", Volume: II and III, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai (2002).

E-REFERENCES

1. **nptel**: Advanced Engineering Mathematics, Prof. Jitendra Kumar, Department of Mathematics, Indian Institute of Technology, Kharagpur, India.

Table 1: CO Vs GA Mapping

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3									1		1
CO 2	3									1		1
CO 3	3	2								1	1	2
CO 4	3	2			1					1	1	1
CO 5	3	2			1					1	1	1
	15	6	0	0	2	0	0	0	0	5	3	6
Scaled Value	3	2			2					1	1	2

$1 - 5 \rightarrow 1$, $6 - 10 \rightarrow 2$, $11 - 15 \rightarrow 3$

0 - No Relation, 1 - Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE			XEC302	L	T	P	C
COURSE NAME			ELECTRONIC DEVICES	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To introduce the operation of different types of semiconductor devices.
- To familiarize the integrated circuits technology.
- To provide knowledge on the characteristics of opto electronic devices

COURSE OUTCOMES:		Domain	Level
CO1	***Define*** the principles of semiconductor physics.	Cognitive	Remembering
CO2	***Describe*** *the operation and characteristics of* semiconductor diodes.	Cognitive	Understanding
CO3	***Understand*** the operation and Characteristics of BJT and FET	Cognitive	Understanding
CO4	***Discuss*** the operation and characteristics of power electronic and optoelectronic diodes	Cognitive	Understanding
CO5	***Illustrate*** the Integrated Circuit fabrication processes**.**	Cognitive	Understanding

UNIT - I Introduction To Semiconductor Technology **9 Hours**

Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.

UNIT - II Junction Diodes And Applications **9 Hours**

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode , Half wave Rectifier, Full wave Rectifier, Bridge Rectifier and Voltage Regulators.

UNIT - III Transistors And Applications **9 Hours**

Bipolar Junction Transistor, I-V characteristics, NPN and PNP Transistors , Ebers-Moll Model, MOS capacitor, C-V characteristics, Junction Field Transistor, VI Characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor.

UNIT - IV Special Electronic Devices **6 Hours**

SCR, DIAC, TRIAC , LED, LDR,LCD, Photodiode, Photo Transistor and solar cell.

UNIT - V Introduction To Integrated Circuit Technology **6+6 Hours**

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45		0	45

TEXT BOOKS

1. Robert L. Boylestad and Louis Nashelsky , "Electronics devices and Circuit Theory" 11th Edition, UBS Publishers, New Delhi, 2013.
2. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
3. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill EducationJacob
4. Millman and Christos C.Halkias, "Electronic Devices and Circuits" 3rd Edition, Tata McGraw Hill,New Delhi, 2010.

REFERENCES

1. C.T. Sah, "Fundamentals of solid state electronics," World Scientific publishing Co. Inc, 1991.
2. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
3. Y.Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford University .Press, 2011.
4. David A. Bell ,"Electronic devices and circuits", Prentice Hall of India, 2004.
5. S.Salivahanan, "Electronics devices and circuits". 2nd Edition, Tata McGraw Hill, 2008.

E-REFERENCES

1. http://www.rtna.ac.th/departments/elect/Data/EE304/Electronic%20Devices%20and%20Circuit%20Theory.pdf
2. http://nptel.ac.in/courses/117103063/ (Prof. Chitralekha Mahanta, NPTEL, Basic Electronics, IIT-Guwahati)
3. http://nptel.ac.in/video.php?subjectId=117103063 (Prof. Gautam Barua, NPTEL, Basic Electronics, IIT-Guwahati)
4. http://nptel.ac.in/courses/117101106/ (Prof. A N chandorkar, NPTEL, Analog Electronics, IIT-Bombay)

Table 1 : Mapping of COs with Pos

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	1	1	1	1	1	1				1		
CO 2	3	2	1	1	1	1	1	1				1		
CO 3	3	2	1	1	1	1	1	1				1		
CO 4	3	2	1	1	1	1	1	1				1		
CO 5	3	2	1	1	1	1	1	1				1		
Total	18	12	6	6	6	6	6	6				6		
Scaled Value	4	3	2	2	2	2	2	2				2		

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE	XEC303	L	T	P	C

COURSE NAME			DIGITAL SYSTEM DESIGN	3	0	0	3
PREREQUISITE							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To introduce basic postulates of Boolean Algebra, methods for simplification of Boolean expression and Code conversion.
- To outline the design of combinational logic circuits.
- To understand the design of sequential logic circuits.
- To introduce the function of logic families and Programmable Logic Devices.
- To implement logic gates, combinational and sequential circuits using VHDL.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Understand*** the fundamental concepts and Karnaugh map techniques used in digital electronics.	Cognitive	Understanding
CO2	***Understand*** the fundamental concepts of combinational logic circuits	Cognitive	Understanding
CO3	***Understand***the fundamental concepts of Sequential logic circuits	Cognitive	Understanding
CO4	Explain the function of LogicFamilies, Memories and Programmable Logic Devices	Cognitive	Understanding
CO5	***Use*****V**HDLto simulate combinational and sequential logic circuits.	Cognitive	Understanding

UNIT - I LOGIC SIMPLIFICATION **9 Hours**

Logic Simplification : Review of Boolean Algebra and DeMorgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps upto 6 variables, Binary codes, Code Conversion.

UNIT - II COMBINATIONAL LOGIC CIRCUITS **9 Hours**

MSI devices : Comparator, Multiplexer, Demultiplexer, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

UNIT - III SEQUENTIAL LOGIC CIRCUITS DESIGN **9 Hours**

Sequential Logic Design : Building blocks S-R, J Kand Master-Slave JKFF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite State Machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits : Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

UNIT - IV LOGIC FAMILIES AND SEMICONDUCTOR MEMORIES **9 Hours**

Logic Families and Semiconductor Memories : TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices : FPGA. Logic implementation using Programmable Devices.

UNIT - V VERY HIGH SPEED INTEGRATED CIRCUIT HARDWARE **9 Hours**

DESCRIPTION LANGUAGE(VHDL)			
VLSI Design flow : Design entry : Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Data flow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.			
HOURS	**LECTURE**	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS

1. R.P.Jain,"ModerndigitalElectronics",TataMcGrawHill,4thedition, 2009.
2. DouglasPerry,"VHDL",TataMcGrawHill,4thedition,2002.
3. W.H.Gothmann, "Digital Electronics – An introduction to theory and practice", PHI, 2nd edition, 2006.
4. D.V.Hall,"DigitalCircuitsandSystems",TataMcGrawHill,1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

REFERENCES

1. M. Morris Mano, and Michael D.Ciletti "Digital Design: with an Introduction to Verilog HDL", VHDL, and System Verilog (6th Edition) 6th Edition, Pearson/Prentice Hall of India Pvt. Ltd., New Delhi, 2017.
2. Thomas L. Floyd, "Digital Fundamentals, 11th Edition, Pearson Education", Inc, New Delhi, 2014.

E REFERENCES

1. Lecture series on Digital Circuits & Systems by Prof.S.Srinivasan, Department of Electrical Engineering, IIT Madras. For more details on NPTEL visit http://nptel.ac.in
2. **http://nptel.ac.in/courses/117106114/**
3. **http://nptel.ac.in/courses/**117106086/1

Table 1 : CO Vs PO Mapping

	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	3	3	2	2	2	1	1				2		
CO 2	3	3	3	2	2	2	1	1				2		
CO 3	3	3	3	2	2	2	1	1				2		
CO 4	3	3	3	2	2	2	1	1				2		
CO 5	3	3	3	2	2	2	1	1				2		
Total	**15**	**15**	**15**	**10**	**10**	**10**	**5**	**5**				**5**		
Scaled Value	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**				**1**		

0 - No Relation 1 - Low Relation , 2 - Medium Relation, 3- High Relation

COURSECODE	XEC304	L	T	P	C

COURSE NAME			SIGNALS AND SYSTEMS	3	0	0	3
PREREQUISITE							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To introduce students the concept and theory of signals and systems needed in electronics and telecommunication engineering fields.
- To introduce students to the basic idea of signal and system analysis and its characterization in time and frequency domain

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** and **C*lassify*** the signals & systems	Cognitive	Remembering Understanding
CO2	***Find*** and ***Apply*** FT and DFT and ***Analyze*** the properties of LSI systems.	Cognitive	Applying Analyzing
CO3	***Find*** and ***solve*** Laplace Transform to study the response of LSI systems	Cognitive	Remembering Applying
CO4	***Find*** and ***solve*** Z transform to study the performance of Discrete Time Signals	Cognitive	Remembering Applying
CO5	***Interpret*** the relation between the continuous and discrete time signals by Sampling and Reconstruction.	Cognitive	Remembering Understanding

UNIT - I INTRODUCTION TO SIGNALS AND SYSTEMS — **9 Hours**

An Introduction to Signals and Systems: Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity, additivity and homogeneity, shift-invariance, causality, stability, realizability.

UNIT- II LINEAR SHIFT INVARIANT (LSI) SYSTEMS — **9 Hours**

Linear Shift Invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

UNIT – III FOURIER TRANSFORM — **9 Hours**

Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases.

UNIT - IV LAPLACE TRANSFORM	9 Hours

The Laplace Transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

UNIT - V SAMPLING THEOREM AND RECONSTRUCTION	9 Hours

State-space analysis and multi-input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

HOURS	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

REFERENCES

1. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
2. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988

E REFERENCES

https://onlinecourses.nptel.ac.in /noc18_ee02/preview

Mapping of COs with POs:

	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	3	2	1	1	1	1	1				1		
CO 2	3	3	2	1	1	1	1	1				1		
CO 3	3	3	2	1	1	1	1	1				1		
CO 4	3	3	2	1	1	1	1	1				1		
CO 5	3	3	2	1	1	1	1	1				1		
Total	**15**	**15**	**10**	**5**	**5**	**5**	**5**	**5**				**5**		
Scaled Value	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**				**1**		

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE			XUM305	L	T	P	C
COURSE NAME			ENTREPRENEURSHIP DEVELOPMENT	2	0	0	2
PREREQUISITE:			Nil	L	T	P	H
C	P	A		2	0	0	2
2.7	0	0.3					

COURSE OUTCOMES		Domain	Level
CO1	***Recognise*** and ***describe*** the personal traits of an entrepreneur.	Affective Cognitive	Receiving Understanding
CO2	***Determine*** the new venture ideas and ***analyse*** the feasibility report.	Cognitive	Understanding Analysing
CO3	***Develop*** the business plan and ***analyse*** the plan as an individual or in team.	Affective Cognitive	Receiving Analysing
CO4	***Describe*** various parameters to be taken into consideration for launching and managing small business.	Cognitive	Understanding
CO5	***Explain the*** technological management and Intellectual Property Rights	Cognitive	Understanding

UNIT - I ENTREPRENEURIAL TRAITS AND FUNCTIONS — **9 Hours**

Definition of Entrepreneurship; competencies and traits of an entrepreneur; factors affecting Entrepreneurship Development; Role of Family and Society ; Achievement Motivation; Entrepreneurship as a career and national development;

UNIT - II NEW PRODUCT DEVELOPMENT AND VENTURE CREATION — **9 Hours**

Ideation to Concept development; Sources and Criteria for Selection of Product; market assessment ; Feasibility Report ;Project Profile; processes involved in starting a new venture; legal formalities; Ownership; Case Study.

UNIT - III ENTREPRENEURIAL FINANCE — **9 Hours**

Financial forecasting for a new venture; Finance mobilization; Business plan preparation; Sources of Financing, Angel Investors and Venture Capital; Government support in startup promotion.

UNIT - IV LAUNCHING OF SMALL BUSINESS AND ITS MANGEMENT — **9 Hours**

Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units.

UNIT - V TECHNOLOGY MANAGEMENT, IPR PORTFOLIO FOR NEW PRODUCT VENTURE — **9 Hours**

Technology management; Impact of technology on society and business; Role of Government in supporting Technology Development and IPR protection; Entrepreneurship Development Training and Other Support Services.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Hisrich, 2016, *Entrepreneurship*, Tata McGraw Hill, New Delhi.

2. S.S.Khanka, 2013, *Entrepreneurial Development*, S.Chand and Company Limited, New Delhi.

REFERENCES

1. Mathew Manimala, 2005, *Entrepreneurship Theory at the Crossroads, Paradigms & Praxis*, Biztrantra ,2nd Edition.
2. Prasanna Chandra, 2009, *Projects – Planning, Analysis, Selection, Implementation and Reviews*, Tata McGraw-Hill.
3. P.Saravanavel, 1997, *Entrepreneurial Development*, Ess Pee kay Publishing House, Chennai.
4. Arya Kumar,2012, *Entrepreneurship: Creating and Leading an Entrepreneurial Organisation*, Pearson Education India.
5. Donald F Kuratko, T.V Rao, 2012, *Entrepreneurship: A South Asian perspective*, Cengage Learning India.
6. Dinesh Awasthi, Raman Jaggi, V.Padmanand, *Suggested Reading / Reference Material for Entrepreneurship Development Programmes* (EDP/WEDP/TEDP), EDI Publication, Entrepreneurship Development Institute of India, Ahmedabad. Available from: http://www.ediindia.org/doc/EDP-TEDP.pdf

E-REFERENCES

1. Jeff Hawkins, " Characteristics of a successful entrepreneur", ALISON Online entrepreneurship courses, "https://alison.com/learn/entrepreneurial-skills
2. Jeff Cornwall, "Entrepreneurship -- From Idea to Launch", Udemy online Education, https://www.udemy.com/entrepreneurship-from-idea-to-launch/

Table 1: COs Vs GA Mapping

CO/GA	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO1	0	0	0	0	0	1	0	0	3	3	0	1
CO2	0	0	1	2	3	2	1	3	1	2	3	0
CO3	0	0	0	0	0	0	0	0	3	3	3	2
CO4	0	0	0	0	0	1	1	2	3	0	3	3
CO5	0	0	0	0	0	1	1	3	0	0	0	3
Original	0	0	1	2	3	5	3	8	10	8	9	9
Scaled	0	0	1	1	1	1	1	2	3	2	2	2

1-5 →1, 6-10 →2, 11-15 →3

0 – No Relation, 1- Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE	XUM306	L	T	P	C
COURSE NAME	CONSTITUTION OF INDIA	0	0	0	0
PREREQUISITE:	NIL	L	T	P	H

C:P:A	0:0:0	3	0	0	3

COURSE OUTCOMES		Domain	Level
CO1	***Understand*** the Constitutional History	Cognitive	Understanding
CO2	***Understand*** the Powers and Functions	Cognitive	Understanding
CO3	***Understand*** the Legislature	Affective	Remembering
CO4	***Understand*** the Judiciary	Affective	Remembering
CO5	***Understand*** the Centre State relations	Cognitive	Understanding

UNIT - I	**08 Hours**

Constitutional History- The Constitutional Rights- Preamble- Fundamental Rights- Fundamental Duties- Directive principles of State Policy.

UNIT - II	**09 Hours**

The Union Executive- The President of India (powers and functions)- Vice-President of India- The Council of Ministers-Prime Minister- Powers and Functions.

UNIT - III	**10 Hours**

Union Legislature- Structure and Functions of Lok Sabha- Structure and Functions of Rajya Sabha- Legislative Procedure in India- Important Committes of Lok Sabha- Speaker of the Lok Sabha.

UNIT - IV	**09 Hours**

The Union Judiciary- Powers of the Supreme Court- Original Jurisdiction- Appelete jurisdictions- Advisory Jurisdiction- Judicial review.

UNIT - V	**09 Hours**

Centre State relations- Political Parties- Role of governor, powers and functions of Chief Minister-Legislative Assembly- State Judiciary- Powers and Functions of the High Courts.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

REFERENCES

1. W.H.Morris Shores- Government and politics of India, NewDelhi,B.1.Publishers,1974.
2. M.V.Pylee- Constitutional Government in India, Bombay, Asia Publishing House, 1977.
3. R.Thanker- The Government and politics of India, London:Macmillon, 1995.
4. A.C.Kapur- Select Constitutions S,Chand & Co.,NewDelhi, 1995
5. V.D.Mahajan- Select Modern Governments,S,Chand &Co, NewDelhi,1995.
6. B.C.Rout- Democractic Constitution of India.
7. Gopal K.Puri- Constitution of India, India 2005.

Table 1: Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	2			1					
CO 2	2			1					
CO 3	2			1					1
CO 4	2			1				1	1
CO 5	2	2		1				1	1
Total	10	2		5				2	3
Scaled to 0,1,2,3	2	1		1				1	1

1-5 →1, 6-10 →2, 11-15 →3

0 – No Relation, 1- Low Relation, 2- Medium Relation, 3- High Relation

COURSE CODE			XEC307	L	T	P	C
COURSE NAME			NETWORK THEORY	3	0	0	3
PREREQUISITES			Mathematics	L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To make the students to understand the basic laws and theorems of AC and DC electrical circuits.
- To familiarize the transient and steady state behaviour of networks.
- To impart the knowledge on the frequency response characteristics of RLC and filter circuits.

COURSE OUTCOMES:		Domain	Level
CO1	***Describe and Understand*** the concepts of nodal, mesh analysis and network theorems.	Cognitive	Remembering Understanding
CO2	Recognize and Distinguish the response of a network	Cognitive	Remembering Understanding
CO3	***Distinguish*** RL, RC and RLC networks and ***Analyze*** their characteristics	Cognitive	Understanding Analyzing
CO4	***Understand*** the various functions of network and the stability of network.	Cognitive	Understanding
CO5	***Classify*** and ***Explain*** *the* different types of filters	Cognitive	Understanding Understanding

UNIT - I DC CIRCUIT ANALYSIS AND NETWORK THEOREMS **9 Hours**

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactance, source transformation and duality.
Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem

UNIT - II TRIGONOMETRIC AND EXPONENTIAL FOURIER SERIES **9 Hours**

Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

UNIT - III TRANSIENT ANALYSIS **9 Hours**

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

UNIT - IV NETWORK FUNCTIONS: POLES AND ZEROS **9 Hours**

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of admittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem

UNIT - V RESONANCE IN RLC CIRCUITS AND FILTERS	6+6

Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to low pass, high pass, band pass and band reject filters.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
HOURS	45		0	45

TEXT BOOKS

1. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015.
2. Valkenburg V., Network Analysis, 3/e, PHI, 2011
3. Sudhakar A,S. P. Shyammohan, Circuits and Networks- Analysis and Synthesis, 5/e, McGrawHill, 2015

REFERENCES

1. Choudhary R., Networks and Systems, 2/e, New Age International, 2013.
2. Franklin F. Kuo, Network Analysis and Synthesis, 2/e, Wiley India, 2012.
3. Pandey S. K., Fundamentals of Network Analysis and Synthesis, 1/e, S. Chand, 2012.
4. Edminister, Electric Circuits – Schaum's Outline Series, McGraw-Hill,2009.
5. T.Nageswara Rao, "Electric Circuit Analysis", A.R Publications, Sirkali ,Tamil Nadu, 2009
6. A. Sudhakar, Shyammohan S. Palli., "Circuits and networks : analysis and synthesis" 1st Edition, McGraw-Hill, 2008

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1. www.nptel.iitm.ac.in/108102042/lec1.pdf, (NPTEL Lecture Series on Circuit Theory by 'Prof.S.C Dutta Roy', Department of Electrical Engineering IIT Delhi).

Table1:Mapping of COs with POs:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	2	1	1	1	1	1	1				1	2	1
CO 2	3	2	1	1	1	1	1	1				1	2	1
CO 3	3	2	1	1	1	1	1	1				1	2	1
CO 4	3	2	1	1	1	1	1	1				1	2	1
CO 5	3	2	1	1	1	1	1	1				1	2	1
Total	15	10	5	5	5	5	5	5				5	10	5
Scaled Value	3	2	1	1	1	1	1	1				1	2	1

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSECODE			XEC308	L	T	P	C
COURSE NAME			ELECTRONIC DEVICES AND NETWORKS LAB	0	0	1	1
PREREQUISITE							
C	P	A		L	T	P	H
2.8	0.1	0.1		0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Construct*** and ***Verify*** the characteristics of semiconductor diodes.	Psychomotor Affective	Perception Receiving Phenomena
CO2	***Construct*** and ***Verify*** the characteristics of Transistors	Psychomotor Affective	Perception Receiving Phenomena
CO3	***Construct*** and study the characteristics of Opto electronic diodes	Psychomotor	Perception
CO4	***Construct*** and study the output of Rectifiers	Psychomotor	Perception
CO5	***Construct and Verify*** the characteristics of Network theorems, filters and resonance circuits.	Psychomotor Affective	Perception Receiving Phenomena

LIST OF EXPERIMENTS

1. V-I characteristics of PN junction diode and Zener diode.
2. V-I characteristics of Input and Output characteristics of Common base configuration of BJT.
3. Input and Output characteristics of Common emitter configuration of BJT.
4. Drain and Transfer characteristics of JFET.
5. Characteristics of LED and LDR.
6. Design and implementation of Half wave and full wave rectifiers.
7. Verification of Reciprocity and Superposition Theorem.
8. Frequency response of low pass and high pass filter
9. Frequency response of series resonance circuit
10. Frequency response of parallel resonance circuit

	PRACTICAL	TOTAL
HOURS	45	45

CO Vs PO Mapping

	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
CO 1	3	3	3	3	2	2	2	1	2	2	1	2		
CO 2	3	3	3	3	2	2	2	1	2	2	1	2		
CO 3	3	3	3	3	2	2	2	1	2	2	1	2	2	1
CO 4	3	3	3	3	2	2	2	1	2	2	1	2	2	1
CO 5	3	3	3	3	2	2	2	1	2	2	1	2	2	1
Total	**15**	**15**	**15**	**15**	**10**	**10**	**10**	**5**	**10**	**10**	**5**	**10**	**6**	**3**
Scaled Value	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**

COURSECODE			XEC309		L	T	P	C
COURSE NAME			DIGITAL SYSTEM DESIGN LAB		0	0	1	1
PREREQUISITE								
C	P	A			L	T	P	H
2.8	0.1	0.1			0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Choose*** the logic gates and ***Use*** them for various applications	Psychomotor Affective	Perception
CO2	***Assemble*** Combinational logic circuits and ***Verify*** their operation	Psychomotor Affective	Response Internalizing values
CO3	***Assemble*** Sequential logic circuits and ***Verify*** their operation	Psychomotor	Response
CO4	***Design*** Counters and Shift Registers and ***Demonstrate*** their output	Psychomotor	Origination
CO5	***Create*** digital circuits and ***display*** the results using VHDL	Psychomotor Affective	Origination Valuing

LIST OF EXPERIMENTS:

1. Study of logic gates.
2. Design and implementation of code converters using logic gates
3. Design and implementation of Adders using logic gates.
4. Design and implementation Subtractor using logic gates.
5. Design and implementation of Magnitude Comparators.
6. Design and implementation of encoder and decoder.
7. Design and implementation of Multiplexer and De-multiplexer.
8. Implementation of Flip- flops.
9. Construction and verification of counter .
10. Construction and verification of shift register.
11. Logic gates using VHDL.
12. Adder and subtractor using VHDL

HOURS	PRACTICAL	TOTAL
	45	45

Table 1 : CO Vs PO Mapping

	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	PSO2
CO 1	3	3	3	3	2	2	2	1	2	2	1	2	-	-
CO 2	3	3	3	3	2	2	2	1	2	2	1	2	-	-
CO 3	3	3	3	3	2	2	2	1	2	2	1	2	-	-
CO 4	3	3	3	3	2	2	2	1	2	2	1	2	-	-
CO 5	3	3	3	3	2	2	2	1	2	2	1	2	-	-
Total	**15**	**15**	**15**	**15**	**10**	**10**	**10**	**5**	**10**	**10**	**5**	**10**	**-**	**-**
Scaled Value	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**-**	**-**

COURSE CODE			XEC401	L	T	P	C
COURSE NAME			PROBABILITY THEORY AND STOCHASTIC PROCESSES	3	1	0	4
C	P	A		L	T	P	H
3.5	0.25	0.25		3	1	0	4

PREREQUISITE: Nil

Learning Objectives:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities and to understand the significance of linear systems with random inputs.

Course Outcomes		Domain	Level
CO1	**Describe** sets, its operation and basics of probability by examples and **solve** problems associated.	Cognitive	Remembering Applying
CO2	**Describe** and **Demonstrate** PMF, PDF, CDF of discrete and continues random variable	Cognitive	Remembering Understanding
CO3	**Describe** Joint distributions and **apply** them to communication systems problems	Cognitive	Remembering Applying
CO4	**Describe** random sequences and limit theorems and **solve** problems	Cognitive	Remembering Applying
CO5	**Describe** stochastic and **solve** problems related to communication system which involves stochastic process.	Cognitive	Remember Applying

UNIT - I	12 Hours
Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Requirements for a random process to be stationary. Rayleigh and Rician distribution in detail. Axioms of probability -Conditional probability -Bayes rule, statistically independent Random variable -CDF - Probability density function-Statistical averages-Moments.	
UNIT - II	**12 Hours**
Discrete random variables, probability mass function, example random variables and distributions; Cumulative Distribution Function (CDF), Averages, and Expected Value of a Derived Random Variable, Variance and Standard Deviation; Continuous random variables, probability density function, probability	

distribution function, example distributions; Gaussian Random Variables, Delta Functions, Mixed Random Variables, Probability Models of Derived Random Variables.

UNIT - III	**12 Hours**

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

UNIT - IV	**12 Hours**

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

UNIT - V	**12 Hours**

Stochastic Processes - Definitions and Examples- Types of Stochastic Processes- Random Variables from Random Processes- Independent Identically Distributed Random Sequences -The Poisson Process - Properties of the Poisson Process - The Brownian Motion Process - Expected Value and Correlation - Stationary Processes - Wide Sense Stationary Stochastic Processes -Cross-Correlation - Gaussian Processes.

	LECTURE	**TUTORIAL**	**TOTAL**
HOURS	**45**	**15**	**60**

TEXTBOOKS

1. Roy D. Yates and David J."Goodman, "Probability and Stochastic Processes", 3rd Edition, John Wiley & Sons, Inc., 2014.
2. H. Stark and J.W.Woods, "Probability and Random Processes with Applications to Signal Processing", Third Edition, Pearson Education, 2002.

REFERENCES

1. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill., 2002
2. Scott Miller and Donald Childers, "Probability and Random Processes, : With Applications to Signal Processing and Communications', 2nd edition, Academic Pres, 2018.
3. Leon-Garcia, Alberto, "Probability, statistics, and random processes for electrical engineering", Pearson Education, Inc.,Upper Saddle River, NJ 07458, 2008.

E REFERENCE

Nptel: Prof. Dr. S. Dharmaraja, "Stochastic Processes", Department of Mathematics, Indian Institute of Technology, Delhi, http://nptel.ac.in/courses/111102014/

TABLE 1: CO VS GA Mapping

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
CO 1	3	2	1						1	1		1
CO 2	3	2	1						1	1		1
CO 3	3	2	1	1					1	1		1
CO 4	3	2	1	1	1	1			1	1	1	1
CO 5	3	2	1	1	1	1	1		1	1	1	1
Total	15	10	5	3	2	2	1		5	5	2	5
Scaled value	3	2	1	1	1	1	1		1	1	1	1

1-5→1, 6-10 → 2, 11-15 → 3

0 – No Relation, 1 – Low Relation, 2 – Medium Relation, 3 – High Relation

COURSE CODE			XUM402	L	T	P	C
COURSE NAME			TOTAL QUALITY MANAGEMENT	2	0	0	2
C	P	A		L	T	P	H
3	0	0		2	0	0	2

LEARNING OBJECTIVES

- To basic concepts of total quality concepts and its limitations.
- To expose the students on Customer satisfaction, Employee involvement, supplier selection and appraise the performance by TQM principle
- To familiarize the Statistical Process Control Tools
- To enhance the fundamental knowledge on the different TQM tools and their significance
- To instill the knowledge of students on the importance aspects of different quality systems

COURSE OUTCOMES		Domain	Level
CO1	***List*** and ***Explain*** the basic concepts of total quality concepts and its limitations.	Cognitive	Remembering Understanding
CO2	***Analyze*** and ***Explain*** the Customer satisfaction, Employee involvement, supplier selection and appraise the performance by TQM principle	Cognitive	Analyzing, Evaluating
CO 3	***Explain*** and ***Apply*** the Statistical Process Control Tools	Cognitive	Understanding, Appling
CO4	***Select*** and ***Explain*** the different TQM tools and their significance	Cognitive	Remembering, Understanding
CO5	***Explain*** the importance aspects of different quality systems.	Cognitive	Understanding

UNIT - I INTRODUCTION — **9 Hours**

Definition of quality – Dimensions of quality – Quality planning – Quality costs – Analysis techniques for quality costs – Basic concepts of Total Quality Management – Historical review –Principles of TQM – Leadership – Concepts – Role of senior management – Quality Council –Quality statements – Strategic planning – Deming philosophy – Barriers to TQM implementation

UNIT - II TQM PRINCIPLES — **9 Hours**

Customer satisfaction – Customer perception of quality – Customer complaints – Service quality – Customer retention – Employee involvement – Motivation, empowerment, teams, recognition and reward – Performance appraisal – Benefits – Continuous process improvement – Juran trilogy – PDSA cycle – 5S – Kaizen – Supplier partnership – Partnering – Sourcing – Supplier selection – Supplier rating – Relationship development – Performance measures – Basic concepts – Strategy – Performance measure.

UNIT - III STATISTICAL PROCESS CONTROL (SPC) — **9 Hours**

The seven tools of quality – Statistical fundamentals – Measures of central tendency and dispersion – Population and sample – Normal curve – Control charts for variables and attributes – Process capability – Concept of six sigma – New seven management tools.

UNIT - IV TQM TOOLS	9 Hours
Benchmarking – Reasons to benchmark – Benchmarking process – Quality Function Deployment (QFD) – House of quality – QFD process – Benefits – Taguchi quality loss function – Total Productive Maintenance (TPM) – Concept – Improvement needs – FMEA – Stages of FMEA.	
UNIT - V QUALITY SYSTEMS	**9**
Need for ISO 9000 and other quality systems – ISO 9000:2000 quality system – Elements – Implementation of quality system – Documentation – Quality auditing – TS 16949 – ISO 14000 – Concept, requirements and benefits.	

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	-	-	45

TEXT BOOKS

1. Dale H. Besterfiled, et. Al. "Total Quality Management", New Delhi, Pearson Education, Inc.2007.
2. James R. Evans and William M. Lidsay, "The Management and Control of Quality", 5th Edition, South-Western, 2002.

REFERENCES

1. Feigenbaum, A.V., "Total Quality Management", McGraw Hill, 1991.
2. Oakland, J.S., "Total Quality Management", Butterworth Heineman, 1989.
3. Narayana V. and Sreenivasan, N.S., "Quality Management – Concepts and Tasks", New Age International, 1996.
4. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

E- REFERENCES

1. http://nptel.ac.in/faq/110101010/Prof.IndrajitMukherjee,IIT,Bombay and Prof.Tapan P.Bagchi, IIT, Kharagpur.

COs Vs GA mapping

	CO1	CO2	CO3	CO4	CO5	Total	Scaled total
GA1	2	1	2	1	1	7	2
GA4	1	1	2	2	1	7	2
GA5	1	1	2	2	1	7	2
GA6	1	1	2	1	2	7	2
GA7	1	1	1	1	1	5	1
GA8	1	1	1	2	2	7	2
GA9	1	1	1	-	1	4	1
GA10	1	1	1	2	2	7	2
GA12	1	1	-	-	2	4	1

COURSE CODE			XUM403	L	T	P	C
COURSE NAME			HUMAN ETHICS, VALUES, RIGHTS AND GENDER EQUALITY	0	0	0	0
C	P	A		L	T	P	H
2.7	0	0.3		3	0	0	3

LEARNING OUTCOMES

- To impart the knowledge on the human ethics and human relationships
- To familiarize gender issues, equality and violence against women
- To expose the students on women issues and challenges
- To introduce human rights and report on violations.
- To emphasis the students on family values, universal brotherhood, fight against corruption by common man and good governance.

COURSE OUTCOMES		Domain	Level
CO1	***Relate*** and ***Interpret*** the human ethics and human relationships	Cognitive	Remembering, Understanding
CO2	***Explain*** gender issues, equality and violence against women	Cognitive	Understanding,
CO3	***Classify*** and ***Develop*** the identify women issues and challenges	Cognitive & Affective	Understanding, Receiving
CO4	***Classify*** and ***Dissect*** human rights and report on violations.	Cognitive	Understanding,
CO5	***List*** and **respond** to family values, universal brotherhood, fight against corruption by common man and good governance.	Cognitive & Affective	Remembering, (Respond)

UNIT - I HUMAN ETHICS AND VALUES — **7 Hours**

Human Ethics and values - Understanding of oneself and others- motives and needs- Social service, Social Justice, Dignity and worth, Harmony in human relationship: Family and Society, Integrity and Competence, Caring and Sharing, Honesty and Courage, WHO's holistic development - Valuing Time, Co-operation, Commitment, Sympathy and Empathy, Self respect, Self-Confidence, character building and Personality.

UNIT - II GENDER EQUALITY — **9 Hours**

Gender Equality - Gender Vs Sex, Concepts, definition, Gender equity, equality, and empowerment. Status of Women in India Social, Economical, Education, Health, Employment, HDI, GDI, GEM. Contributions of Dr.B.R. Ambethkar, Thanthai Periyar and Phule to Women Empowerment.

UNIT - III WOMEN ISSUES AND CHALLENGES	9 Hours
Women Issues and Challenges- Female Infanticide, Female feticide, Violence against women, Domestic violence, Sexual Harassment, Trafficking, Access to education, Marriage. Remedial Measures – Acts related to women: Political Right, Property Rights, and Rights to Education, Medical Termination of Pregnancy Act, and Dowry Prohibition Act.	
UNIT - IV HUMAN RIGHTS	**9 Hours**
Human Rights Movement in India – The preamble to the Constitution of India, Human Rights and Duties, Universal Declaration of Human Rights (UDHR), Civil, Political, Economical, Social and Cultural Rights, Rights against torture, Discrimination and forced Labour, Rights and protection of children and elderly. National Human Rights Commission and other statutory Commissions, Creation of Human Rights Literacy and Awareness. - Intellectual Property Rights (IPR). National Policy on occupational safety, occupational health and working environment.	
UNIT - V GOOD GOVERNANCE AND ADDRESSING SOCIAL ISSUES	**11 Hours**
Good Governance - Democracy, People's Participation, Transparency in governance and audit, Corruption, Impact of corruption on society, whom to make corruption complaints, fight against corruption and related issues, Fairness in criminal justice administration, Government system of Redressal. Creation of People friendly environment and universal brotherhood.	

HOURS	LECTURE	SELF STUDY	TOTAL
	45	-	45

REFERENCES

1. Aftab A, (Ed.), Human Rights in India: Issues and Challenges, (New Delhi: Raj Publications, 2012).
2. Bajwa, G.S. and Bajwa, D.K. Human Rights in India: Implementation and Violations (New Delhi: D.K. Publications, 1996).
3. Chatrath, K. J. S., (ed.), Education for Human Rights and Democracy (Shimala: Indian Institute of Advanced Studies, 1998).
4. Jagadeesan. P. Marriage and Social legislations in Tamil Nadu, Chennai: Elachiapen Publications, 1990).
5. Kaushal, Rachna, Women and Human Rights in India (New Delhi: Kaveri Books, 2000)
6. Mani. V. S., Human Rights in India: An Overview (New Delhi: Institute for the World Congress on Human Rights, 1998).
7. Singh, B. P. Sehgal, (ed) Human Rights in India: Problems and Perspectives (New Delhi: Deep and Deep, 1999).
8. Veeramani, K. (ed) Periyar on Women Right, (Chennai: Emerald Publishers, 1996)
9. Veeramani, K. (ed) Periyar Feminism, (Periyar Maniammai University, Vallam, Thanjavur: 2010).
11. Planning Commission report on Occupational Health and Safety http://planningcommission.nic.in/aboutus/committee/wrkgrp12/wg_occup_safety.p
11. Central Vigilance Commission (Gov. of India) website: http://cvc.nic.in/welcome.html.
12. Weblink of Transparency International: https://www.transparency.org/
13. Weblink Status report: https://www.hrw.org/world-report/2015/country-chapters/india

Table 1 : Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2						
CO2								3	1					
CO3								2						
CO4								3		2				
CO5								3	2	2		2		
Total								13	3	4		2		
Scaled Value								3	1	1		1		

1 – 5 → 1, 6-10 → 2, 11 – 15→ 3

0 – No relation, 1 – Low relation, 2 – Medium relation, 3 – High relation

COURSECODE	XEC404	L	T	P	C
COURSE NAME		3	0	0	3

PREREQUISITE			ELECTRODYNAMICS AND ELECTROMAGNETIC WAVES				
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**0**	**0**	**3**

LEARNINGOBJECTIVES

- To instill the knowledge on the conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To acquire the basic knowledge of the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To familiarize wave propagation in lossless and in lossy media
- To educate the students to solve problems based on the above concepts

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Classify*** the basic Electrostatic theorems and laws.	Cognitive	Applying
CO2	***Discuss*** the behavior of Electric fields in matter and Polarization concepts.	Cognitive	Understanding
CO3	***Classify*** the basic Magneto static theorems and laws and *Infe*r the magnetic properties of matter.	Cognitive	Applying
CO4	***Summarize*** the concepts of electrodynamics and *Derive* the Maxwell's equations.	Cognitive	Understanding
CO5	***Familia*rize** Electromagnetic wave propagation and Polarization	Cognitive	Understanding

UNIT - I **9 Hours**

Electrostatics. Coulomb'slaw. Gauss's law and applications. Electric potential. Poisson's and Laplace equations. Method of images. Multipole Expansion.

UNIT - II **9 Hours**

Electrostatic fields in matter. Dielectrics and electric polarization. Capacitors with dielectric substrates. Linear dielectrics. Force and energy in dielectric systems.

UNIT - III **9 Hours**

Magneto statics. Magnetic fields of steady currents. Biot-Savart's and Ampere 'slaws. Magnetic vector potential. Magnetic properties of matter.

UNIT - IV **9 Hours**

Electrodynamics. Flux rule for motional emf. Faraday's law. Self and mutual inductances. Maxwell's Equations. Electromagnetic Boundary conditions. Poynting theorem.

UNIT - V **9 Hours**

Electromagnetic wave propagation. Uniform plane waves. Wave polarization. Waves in matter. Reflection and transmission at boundaries. Propagation in an ionized medium.

HOURS	**LECTURE**	**TUTORIAL**	**TOTAL**

	45	**0**	**45**

TEXT BOOKS

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989 (UNIT I, II,III IV,V)
2. W.H. Hayt and J.A. Buck, Engineering electrmagnetics, 7th ed., McGraw-Hill (India), 2006
3. E.C. Jordan & G. Balmain, "Electromagnetic Waves and Radiating Systems", PHI,1995.

REFERENCES

1. D.J. Griffiths, Introduction to electrodynamics, 4th ed., Pearson (India), 2013
2. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011
3. M.N.O. Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford (Asian Edition), 2015
4. W.H.Hayt, "Engineering Electromagnetics, (7/e)", McGraw Hill, 2006.
5. D.K.Cheng, "Field and Wave Electromagnetics, (2/e)", Addison Wesley, 1999.
6. N.NarayanaRao, "Elements of Engineering Electromagnetics, (6/e)", Pearson, 2006.
7. R.E.Collin, "Foundations for Microwave Engineering (2/e)", McGraw –Hill, 2002.
8. R.E.Collin, "Antennas and Radio wave Propagation", McGraw-Hill, 1985.

E REFERENCES

1. http://nptel.ac.in/courses/115101004/

CO Vs PO Mapping

	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**	**PS O2**
CO 1	3	3	3	2	1	1	1	1				2	-	2
CO 2	3	3	3	2	1	1	1	1				2	-	2
CO 3	3	3	3	2	1	1	1	1				2	-	2
CO 4	3	3	3	2	1	1	1	1				2	-	2
CO 5	3	3	3	2	1	1	1	1				2	-	2
	15	**15**	**15**	**10**	**5**	**5**	**5**	**5**				**10**		**10**
	3	**3**	**3**	**2**	**1**	**1**	**1**	**1**				**2**		**2**

COURSECODE			XEC405	L	T	P	C
COURSE NAME			TRANSMISSION LINES AND WAVEGUIDES	3	0	0	3
PREREQUISITE							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To introduce the various types of transmission lines and its characteristics
- To give thorough understanding about high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using smith chart
- To introduce passive filters and basic knowledge of active RF components
- To get acquaintance with RF system transceiver design

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Explain*** the various types of transmission lines and its characteristics	Cognitive	Understanding
CO2	***Understand*** the high frequency line, power and impedance measurements	Cognitive	Understanding
CO3	***Analyze*** the characteristics of TE and TM waves	Cognitive	Understanding
CO4	***Analyze*** impedance matching using smith chart	Cognitive	Understanding
CO5	***Understand*** passive filter, active RF components and system transceiver design	Cognitive	Understanding

UNIT - I TRANSMISSION LINE THEORY **9 Hours**

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT - II HIGH FREQUENCY TRANSMISSION LINES **9 Hours**

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

UNIT - III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES	9 Hours
Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.	
UNIT - IV WAVEGUIDES	**9 Hours**
General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides.	
UNIT - V RF SYSTEM DESIGN CONCEPTS	**9 Hours**
Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.	

HOURS	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS

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

REFERENCE BOOKS

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

CO Vs PO Mapping

	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	3	2	2	1	1	1	1				1	2	1
CO 2	3	3	2	2	1	1	1	1				1	2	1
CO 3	3	3	2	1	1	1	1	1				1	2	1
CO 4	3	3	2	1	1	1	1	1				1	2	1
CO 5	3	3	2	2	1	1	1	1				1	2	1
Total	**15**	**15**	**10**	**8**	**5**	**5**	**5**	**5**				**5**	**10**	**5**
Scaled Value	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**				**1**	**2**	**1**

COURSECODE			XEC406	L	T	P	C
COURSE NAME PREREQUISITE			ANALOG COMMUNICATION	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To introduce the concepts of various analog modulations and their spectral characteristics
- To impart the knowledge of effect of Noise in various communications
- To enhance the fundamental knowledge on pulse modulation system and *Differentiate* their system performance
- To emphasis the students with FDM and TDM techniques

	COURSE OUTCOMES	DOMAIN	LEVEL
CO1	***Understand*** the basics of communication system and analog modulation techniques and Frequency Division Multiplexing	Cognitive	Understanding
CO2	***Illustrate*** the concept of Frequency modulation	Cognitive	Understanding
CO3	***Explain*** the effect of Noise in AM Receiver System.	Cognitive	Understanding
CO4	***Estimate*** the effect of noise performance of FM system.	Cognitive	Understanding
CO5	***Classify*** the various pulse modulation techniques and TDM Systems.	Cognitive	Understanding

UNIT – I **9 Hours**

Basic blocks of Communication System. Amplitude (Linear) Modulation – AM, DSB-SC, SSB-SC and VSB-SC. Methods of generation and detection. FDM. Super Heterodyne Receivers.

UNIT - II **9 Hours**

Angle (Non-Linear) Modulation - Frequency and Phase modulation. Transmission Bandwidth of FM signals, Methods of generation and detection. FM Stereo Multiplexing.

UNIT – III **9 Hours**

Noise - Internal and External Noise, Noise Calculation, Noise Figure. Noise in linear and nonlinear AM receivers, Threshold effect.

UNIT – IV **9 Hours**

Noise in FM receivers, Threshold effect, Capture effect, FM Threshold reduction, Pre-emphasis and De-emphasis.

UNIT - V			9 Hours
Pulse Modulation techniques – Sampling Process, PAM, PWM and PPM concepts, Methods of generation and detection. TDM. Noise performance.			
HOURS	**LECTURE**	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS

1. S.Haykins, Communication Systems , Wiley, (4/e), Reprint 2009.
2. Kennedy, Davis, Electronic Communication Systems (4/e), McGraw Hill, Reprint 2008.

REFERENCE BOOKS

1. B.Carlson, Introduction to Communication Systems, McGraw-Hill, (4/e), 2009.
2. J.Smith, Modern Communication Circuits (2/e), McGraw Hill, 1997.
3. J.S.Beasley&G.M.Miler, Modern Electronic Communication (9/e), Prentice-Hall, 2008.

E REFERENCES

1. http://nptel.ac.in /courses/ NPTEL, Communication Engineering ,Prof.Surendra Prasad, Department of Electrical Engineering , Indian Institute of Technology, New Delhi
2. http://freevideolectures.com/course/2311/Digital Communication (NPTEL, DigitalCommunication , Prof.Bikash Kumar Dey, IIT Bombay.
3. http://www.nptel.ac.in/syllabus/117105077, IIT Kharagpur.

CO Vs PO Mapping

	PO1	PO 2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3	2	2	1	1	1	1				1		1
CO 2	3	3	2	2	1	1	1	1				1		1
CO 3	3	3	2	1	1	1	1	1				1		1
CO 4	3	3	2	1	1	1	1	1				1		1
CO 5	3	3	2	2	1	1	1	1				1		1
Total	**15**	**15**	**10**	**8**	**5**	**5**	**5**	**5**				**5**		**5**
Scaled Value	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**				**1**		**1**

COURSECODE			XEC407	L	T	P	C
COURSE NAME			ELECTRONIC CIRCUITS	3	0	0	3
PREREQUISITE							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OUTCOMES

- To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To impart the knowledge on feedback amplifiers and oscillators principles
- To design oscillators.
- To expose the students about turned amplifier.
- To enhance the knowledge on the analysis and design of LC and RC oscillators, amplifiers, multi vibrators, power amplifiers and DC convertors.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Design*** and ***analyze*** feedback amplifiers	Cognitive	Understanding Analyzing
CO2	***Design*** Oscillator circuits	Cognitive	Understanding
CO3	***Illustrate*** the frequency response of tuned amplifiers	Cognitive	Understanding
CO4	***Discuss*** wave shaping circuits and multivibrators.	Cognitive	Understanding
CO5	***Explain*** the working principle of power amplifiers, DC converters	Cognitive	Understanding

UNIT – I FEEDBACK AMPLIFIERS AND STABILITY **9 Hours**

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

UNIT – II OSCILLATORS **9 Hours**

Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt‘s oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

UNIT – III TUNED AMPLIFIERS **9 Hours**

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

UNIT – IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS	9 Hours
Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.	
UNIT – V POWER AMPLIFIERS AND DC CONVERTERS	**9 Hours**
Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	0	45

TEXT BOOKS

1. Sedra and Smith, ―Micro Electronic Circuits‖; Sixth Edition, Oxford University Press,2011.
2. Jacob Millman, _Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009.

REFERENCE BOOKS

1. Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, ―Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., ―Pulse Digital and Switching Waveforms‖, TMH, 2000.
4. Millman and Halkias. C., Integrated Electronics, TMH, 2007.

CO Vs PO Mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3	2	2	1	1	2	1		1		2		
CO 2	3	3	2	2	1	1	2	1		1		2		
CO 3	3	3	2	1	1	1	2	1		1		2		
CO 4	3	3	2	1	1	1	2	1		1		2		
CO 5	3	3	2	2	1	1	2	1		1		2		
Total	**15**	**15**	**10**	**8**	**5**	**5**	**10**	**5**		**5**		**10**		
Scaled Value	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**1**		**1**		**2**		

COURSECODE			XEC408	L	T	P	C
COURSE NAME			MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3
PREREQUISITE							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To make the students understand the Architecture of 8086 microprocessor.
- To educate the students the design aspects of I/O and Memory Interfacing circuits.
- To impart the knowledge to the students to interface microprocessors with supporting chips.
- To give insight into the Architecture of 8051 microcontroller.
- To emphasize the students to design a microcontroller based system

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Illustrate*** the architecture and function of 8086 microprocessor	Cognitive	Understanding
CO2	***Classify various types of buses*** *in the* 8086 microprocessor	Cognitive	Understanding
CO3	***Summarize*** I/O interfacing techniques.	Cognitive	Understanding
CO4	***Explain*** the architecture of 8051 microcontroller.	Cognitive	Understanding
CO5	***Illustrate*** and ***Design*** 8051 microcontroller based systems for various applications	Cognitive	Understanding

UNIT - I THE 8086 MICROPROCESSOR — **9 Hours**

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

UNIT - II 8086 SYSTEM BUS STRUCTURE — **9 Hours**

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

UNIT - III I/O INTERFACING — **9 Hours**

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

UNIT - IV MICROCONTROLLER	9 Hours
Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming.	
UNIT - V INTERFACING MICROCONTROLLER	**9 Hours**
Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.	

HOURS	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOKS

1. Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, ―The 8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Second Edition, Pearson education, 2011.
3. J.L.Antonakos, "An Introduction to the Intel Family of Microprocessors", Pearson, 1999.
4. D. V. Hall, "Micro processors and Interfacing", 2nd Edition, Tata McGrawHill, 2006.
5. Ramesh S. Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5thEdition, Prentice Hall,2014.
6. M.A.Mazidi&J.C.Mazidi "Microcontroller and Embedded systems using Assembly & C. (2/e)", Pearson Education, 2007.
7. John H. Davies**,"** MSP430 Microcontroller Basics", Elsevier Ltd., 2008.

REFERENCE BOOKS

1. B.B. Brey, "The Intel Microprocessors, (7/e), Eastern Economy Edition" , 2006.
2. K.J. Ayala, "The 8051 Microcontroller ", (3/e), Thomson Delmar Learning, 2004.
3. I. S. MacKenzie and R.C.W.Phan., " The 8051 Microcontroller.(4/e)", Pearson education, 2008.
4. A.K.Ray and K.M.Bhurchandani, "Advanced Microprocessors and Peripherals",2nd Edition, TMH, 2006.
5. K.UmaRao, AndhePallavi, "The 8051 Microcontrollers, Architecture and programming and Applications", Pearson Education, 2009.
6. Liu and G.A.Gibson, "Micro Computer System 8086/8088 Family Architecture. Programming and Design",2nd Edition, PHI, 1986.
7. Ajay.V. Deshmukh "Microcontrollers and Applications", TMGH, 2005.
8. Doughlas V.Hall, ―Microprocessors and Interfacing, Programming and Hardware‖,TMH,2012
9. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGraw Hill, 2012

E REFERENCES

1. https://onlinecourses.nptel.ac.in/noc18_ec03/preview
2. http://www.avr-tutorials.com/general/microcontrollers-basics

3. https://www.tutorialspoint.com/embedded_systems/es_microcontroller.htm

CO Vs PO Mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3	2	2	1	1	1	1				1		
CO 2	3	3	2	2	1	1	1	1				1		
CO 3	3	3	2	1	1	1	1	1				1		
CO 4	3	3	2	1	1	1	1	1				1		
CO 5	3	3	2	2	1	1	1	1				1		
Total	**15**	**15**	**10**	**8**	**5**	**5**	**5**	**5**				**5**		
Scaled Value	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**				**1**		

COURSECODE			XEC409	L	T	P	C
COURSE NAME			ELECTRONIC CIRCUITS LAB	0	0	1	1
PREREQUISITE							
C	P	A		L	T	P	H
2.8	0.1	0.1		0	0	2	2

LEARNING OBJECTIVES

- To instill the knowledge of students on feedback amplifiers
- To expose the students on the performance of various oscillators
- To enhance the knowledge of the students on the performance of Tuned amplifiers
- To develop the an understanding the performance of Multivibrators
- To educate the students on the waveforms of clippers and clampers

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Verify*** series and shunt feedback amplifiers	Psychomotor	Perception
CO2	***Design*** various oscillators	Psychomotor	origination
CO3	***Design*** and verify Tuned amplifiers	Psychomotor	Mechanism
CO4	***Design*** and ***demonstrate*** Multivibrators	Psychomotor Affective	origination Valuing
CO5	***Construct*** and observe the waveform clippers and clampers	Psychomotor Affective	Mechanism, Receiving Phenomena

LIST OF EXPERIMENTS

1. Series feedback amplifiers-Frequency response, Input and output impedance
2. Shunt feedback amplifiers-Frequency response, Input and output impedance
3. RC Phase shift oscillator
4. Wien Bridge Oscillator
5. Hartley Oscillator
6. Colpitts Oscillator
7. Single Tuned Amplifier
8. RC Integrator and Differentiator circuits
9. Astable multivibrators
10. Monostable multivibrators
11. Clippers
12. Clampers

	PRACTICAL	TOTAL
HOURS	**45**	**45**

CO Vs PO Mapping

	PO1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO 1	3	3	2	2	2	2	2	1	2	1	1	2		
CO 2	3	3	2	2	2	2	2	1	2	1	1	2		
CO 3	3	3	2	2	2	2	2	1	2	1	1	2		
CO 4	3	3	2	2	2	2	2	1	2	1	1	2		
CO 5	3	3	2	2	2	2	2	1	2	1	1	2		
Total	**15**	**15**	**10**	**10**	**10**	**10**	**10**	**5**	**10**	**5**	**5**	**10**		
Scaled Value	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**		

COURSECODE			XEC410	L	T	P	C
COURSE NAME			MICROPROCESSOR AND MICROCONTROLLERS LAB	0	0	1	1
PREREQUISITE							
C	P	A		L	T	P	H
2.8	0.1	0.1		0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Verify*** the basic program in Microprocessor systems design with 8085.	Psychomotor	Perception,
CO2	***Design*** and ***perform*** the Interfacing of peripherals with 8085 Microprocessor.	Psychomotor Affective	origination, Internalising Values
CO3	***Assemble*** *and* ***verify*** the 8051 Microcontroller based arithmetic operations.	Psychomotor	Mechanism,
CO4	***Design*** and ***demonstrate*** the Interfacing processes with different priority and real time constraints with 8051 Microcontroller.	Psychomotor Affective	origination, Valuing
CO5	***Construct*** *and* ***indentify*** the timer applications using 8051 Microcontroller.	Psychomotor Affective	Mechanism, Receiving Phenomena

LIST OF EXPERIMENTS

1. Programs for 8/16 bit Arithmetic operations Using 8085.
2. Programs for Sorting and Searching Using 8085.
3. Parallel Communication between two MP Kits using Mode 1 and Mode 2 of 8255 with 8085.
4. Interfacing and Programming of Stepper Motor 8085/8086.
5. Interfacing and Programming 8279, 8259, and 8253with 8085/8086.
6. Interfacing ADC and DAC using 8085.
7. Programming using Arithmetic, Logical and Bit Manipulation Instructions of 8051 Microcontroller.
8. Serial Communication between two Microcontroller Kits using 8051.
9. Communication between 8051 Microcontroller kit and PC.
10. Interfacing and Programming of DC Motor using 8051.
11. Interfacing ADC and DAC using 8051.

12. Programming and verifying Timer, Interrupts and UART operations in 8051Microcontroller.		
HOURS	**PRACTICAL**	**TOTAL**
	45	**45**

CO Vs PO Mapping

	PO1	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	3	3	2	2	2	2	2	1	2	1	1	2		
CO 2	3	3	2	2	2	2	2	1	2	1	1	2		
CO 3	3	3	2	2	2	2	2	1	2	1	1	2		
CO 4	3	3	2	2	2	2	2	1	2	1	1	2		
CO 5	3	3	2	2	2	2	2	1	2	1	1	2		
Total	**15**	**15**	**10**	**10**	**10**	**10**	**10**	**5**	**10**	**5**	**5**	**10**		
Scaled Value	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**		

COURSECODE			XEC501	L	T	P	C
COURSE NAME			ANALOG INTEGRATED CIRCUITS	3	0	0	3
PREREQUISITES			Electronic Devices, Electronic Circuits				
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To introduce the basic building blocks of linear integrated circuits
- To familiarize the linear and non-linear applications of operational amplifiers
- To impart the knowledge on the theory and applications of analog multipliers and PLL
- To disseminate the theory of ADC and DAC
- To enhance the fundamental knowledge on the concepts of waveform generation and introduce some special function ICs

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Understand*** the principles of differential amplifiers and operational amplifiers.	Cognitive	Understanding
CO2	***Analyze*** the working of operational amplifiers and basic applications.	Cognitive	Analyzing
CO3	***Apply*** the principles of op-amp for various applications.	Cognitive	Applying
CO4	***Understand*** the working of multivibrators, filters, schimitt trigger.	Cognitive	Understanding
CO5	***Understand*** and carry out the working of specialized ICs.	Cognitive	Understanding

UNIT I - DIFFERENTIAL AMPLIFIERS **(9 Hours)**

Differential amplifiers: Differential amplifier configurations using BJT, Large and small signal operations, input resistance, voltage gain, CMRR, non – ideal characteristics of differential amplifiers, frequency response of differential amplifiers, Operational amplifiers: Introduction, Block diagram, Ideal op-amp parameters, Equivalent circuit, Voltage transfer curve, Open loop

op-amp configurations, Effect of finite open loop gain, Bandwidth and slew rate on circuit performance.

UNIT II - OP-AMP WITH NEGATIVE FEEDBACK	**(9 Hours)**

Introduction, Feedback configurations, voltage series feedback, voltage shunt feedback, properties of practical op-amp, Op-amp applications: Inverting and non inverting amplifier, DC and AC amplifiers, Summing, Scaling and averaging amplifiers, Instrumentation amplifier.

UNIT III - OP-AMP APPLICATIONS	**(9 Hours)**

Voltage to current converter, Current to voltage converter, Integrator, Differentiator, Precision rectifiers, Log and antilog amplifier, RC Phase Shift, Wien bridge ,Hartley, Colpitts and Crystal oscillators.

UNIT IV - MULTIVIBRATORS AND FILTERS	**(9 Hours)**

Bistable, monostable and astable multivibrators, Triangular and saw tooth wave generators, Comparators, Zero crossing detector, Schmitt Trigger, Active filters: Advantages, First and second order low pass, High pass, Band pass and band reject filters, Design of filters using Butterworth approximations.

UNIT V: SPECIALIZED ICS AND ITS APPLICATIONS	**(9 Hours)**

Timer IC 555: Bistable, monostable and astable operations, applications, Analog multipliers, VCO, PLL and its applications Data converters: A/D converters, D/A converters.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS

1. D.Roy Choudhry, Shail Jain, - Linear Integrated Circuits‖, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, - Design with Operational Amplifiers and Analog Integrated Circuits‖, 4th Edition, Tata Mc Graw-Hill, 2016
3. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 4/e, Tata McGraw Hill, 2015

REFERENCES

1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010
2. A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010
3. Ramakant A. Gayakwad, ―OP-AMP and Linear ICs‖, 4th Edition, Prentice Hall / Pearson Education, 2015.
4. Robert F.Coughlin, Frederick F.Driscoll, ―Operational Amplifiers and Linear Integrated Circuits‖, Sixth Edition, PHI, 2001.

5. William D.Stanley, ―Operational Amplifiers with Linear Integrated Circuits‖, Pearson Education,4th Edition,2001.

E REFERENCES

1. https://nptel.ac.in/courses/108106068/

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3		2	1				2			1		
CO 2	3	3		2	1					2		1		
CO 3	3	3		2	1				3	2		1		
CO 4	1	2		2	1							1		
CO 5	1	2		2	1					2		1		
Total	11	13		10	5				5	6		5		
Scaled Value	3	3		2	1				1	2		1		

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

OURSE CODE			XEC502	L	T	P	C
COURSE NAME			DIGITAL COMMUNICATION	3	0	0	3
PREREQUISITES			XEC303, XEC404	L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To impart the knowledge on the principles of sampling & quantization
- To instruct the various waveform coding schemes
- To familiarize the various baseband transmission schemes
- To enhance the fundamental knowledge on the various band pass signaling schemes
- To equip the students with the fundamentals of channel coding

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** various methods to mitigate the effects of noise and ISI in baseband pulse transmission.	Cognitive	Remembering
CO2	***Explain and compare*** various digital modulation techniques	Cognitive	Understanding, Evaluate
CO3	***Describe*** and ***apply*** various error control techniques for reducing bit errors in digital communication.	Cognitive	Remembering, Applying
CO4	***Explain*** and ***illustrate*** Spread Spectrum Communication.	Cognitive	Understanding
CO5	***Explain*** Multiple Access Schemes	Cognitive	Understanding

UNIT I - COMMUNICATION THROUGH BANDLIMITED CHANNELS	(9 Hours)
Matched Filter- Error Rate due to noise –Inter symbol Interference- Nyquist's criterion for Distortion less Base band Binary Transmission- Correlative level coding –Baseband and Mary PAM transmission –Equalization – Linear, DFE and MLSE methods–Eye patterns	
UNIT II - DIGITAL MODULATION	**(9 Hours)**
Introduction – Geometric Representation of Signals -Conversion of the Continuous AWGN Channel into a Vector Channel - Optimum Receivers Using Coherent Detection- Probability of Error- Pass band Transmission model- Generation, Detection, Signal space diagram, bit error probability and Power spectra of ASK,BPSK, QPSK,QAM, FSK and MSK schemes – Differential phase shift keying – Comparison of Digital modulation systems using a single carrier – Carrier and symbol synchronization.	
UNIT III - ERROR CONTROL CODING	**(9 Hours)**
Discrete memoryless channels – Linear block codes - Cyclic codes - Convolutional codes –Maximum likelihood decoding of convolutional codes-Viterbi Algorithm, Trellis codedModulation, Turbo codes, Introduction to LDPC codes, Polar Codes: Channel combining, Channel splitting, Polar coding	
UNIT IV-SPREAD SPECTRUM COMMUNICATION	**(9 Hours)**
Pseudo- noise sequences –a notion of spread spectrum – Direct sequence spread spectrum with coherent binary phase shift keying – RAKE Receiver, Signal space Dimensionality and processing gain –Probability of error – Frequency –hop spread spectrum –Pseudorandom Sequence Generation ,Maximum Length Sequences , Gold Sequences , Barker Sequences , Time-Hopping Spread Spectrum System with Pseudorandom Pulse Position Selection. Case study on SS for 3G, Wireless LAN and Satellite systems.	

UNIT V - MULTIPLE ACCESS TECHNIQUES	(9 Hours)
Introduction- Frequency Division Multiple Access-Time Division Multiple Access- Code Division Multiple Access-Single-Carrier CDMA-Multi-Carrier CDMA-Orthogonal Frequency Division Multiple Access-Single-Carrier FDMA-Space Division Multiple Access- Case Study: Multiple Access Scheme in GSM, 3GPP LTE Cellular System	

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Simon Haykins, "Communication Systems", 4th Edition, John Wiley & Sons, Reprint 2008.
2. Wesołowski, "Introduction to Digital Communication Systems", John Wiley & Sons, 2009.

REFERENCES

1. John Proakis, Massoud Salehi, "Digital Communications", 5th Editions, McGraw Hill Education India, 2014.
2. John R.Barry, Edward A. Lee, David G.Messerschmitt, "Digital Communication", 3rd Edition, Kluwer Academic Publishers, 2004.
3. E. Arıkan, "Channel polarization: A method for constructing capacity-achieving codes for symmetric binary-input memoryless channels," IEEE Trans. Inform. Theory, vol. 55, pp. 3051–3073, July 2009.

E- REFERENCES

1. http://freevideolectures.com/Course/2311/Digital-Communication(NPTEL,Digital Communication, Prof. Bikash Kumar Dey,IIT Bombay)
2. http://www.nptel.ac.in/syllabus/117105077/ (NPTEL, Digital Communication, Prof. SaswatChakrabarti, Prof. R.V. Rajakumar,IIT Kharagpur)

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	1	3								1		2	2	3
CO 2	1	3										1	2	3
CO 3	1	3								1		1	2	3
CO 4	1	2										1	2	3
CO 5		2										1	2	3
Total	4	13	0	0	0	0	0	0	0	2		6	10	15
Scaled Value	1	3	0	0	0	0	0	0	0	1	0	2	2	3

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE			XEC503	L	T	P	C
COURSE NAME			COMPUTER ARCHITECTURE AND ORGNAISATION	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To make the students to understand the basic structure and operation of digital computer.
- To familiarize the students with the arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations and memory system.
- To expose the students with the different ways of communicating with I/O devices and standard I/O interfaces.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Recognize*** the operation of functional units of a computer	Cognitive	Understanding
CO2	***Describe and compute*** the operation of hardware units associated with a computing device.	Cognitive	Remembering Applying
CO3	***Demonstrate*** the operation of processing unit.	Cognitive	Understanding
CO4	***Compare*** the performance of different types of memory	Cognitive	Analyzing
CO5	***Recognize*** the operation of interfacing devices.	Cognitive	Understanding

UNIT I - BASIC STRUCTURE OF COMPUTERS **9 Hours**

Functional Units - Bus Structures - Performance - Evolution - Machine Instructions and programs - Memory operations - Instruction and instruction sequencing - addressing modes - Basic I/O operations - stacks and queues - subroutines - Encoding of Machine instructions.

UNIT II - ARITHMETIC UNIT **9 Hours**

Arithmetic - Design of fast adders - Binary Multiplication - Division - Floating point numbers and operations.

UNIT III - BASIC PROCESSING UNIT **9 Hours**

Processing unit - Fundamental concepts - Execution of a complete instruction - Multiple bus organization - Hardwired control – Micro programmed control - pipelining - Basic concepts - Hazards - Inference on instruction sets. Data path and control considerations - Performance issues.

UNIT IV - MEMORY SYSTEM **9 Hours**

RAM and ROM - Cache memories - Performance considerations - Virtual memories - secondary storage devices - Associative memories.

UNIT V - INPUT / OUTPUT ORGANIZATION				9 Hours
Accessing I/O devices - Interrupts - DMA - Buses - Interface circuits - standard I/O Interfaces. Case study of one RISC and one CISC processor.				
HOURS	**LECTURE**	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	45	**0**	**0**	**45**

TEXT BOOKS

1. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 6th Edition, Mc Graw-Hill Inc, 2012.

REFERENCES

1. John P Hayes, "Computer Architecture and Organisation", Third edition, McGraw Hill , 2012.
2. David A Patterson and John L. Hennessy, 2002. " Computer Organisation and Design The Hardware / Software Interface", 2nd edition, Harcourt Asia, Morgan Kaufmann.
3. William Stallings "Computer Organization and Architecture", Seventh Edition, Pearson Education, 2006.

E-REFERENCES

1. https://www.nptel.ac.in/courses/106106092/
2. http://www.nptelvideos.in/2012/11/computer-organization.html

Table 1 :COs versus POs mapping

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	2	2	1						1		1		
CO 2	2	2	2	1						1		1		
CO 3	2	2	2	1								1		
CO 4	2	2	2	1					2			1		
CO 5	2	2	2	1								1		
Total	10	10	10	5	0	0	0	0	2	2	0	5	0	0
Scaled value	2	2	2	1	0	0	0	0	1	1	0	1	0	0

1-5 → 1, 6-10 → 2, 11-15 → 3

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE			XEC504	L	T	P	C
COURSE NAME			DIGITAL SIGNAL PROCESSING	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To introduce the mathematical approach to manipulate discrete time signals, which are useful to learn digital telecommunication.
- To bring out the concepts related to DFT and its computation
- To bring out the analysis and design techniques for digital filters
- To impart the concept of finite word length effect in signal processing
- To provide thorough understanding on the fundamentals and various types of digital signal processors

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Find*** and ***analyze*** Discrete Fourier Transform to signal processing	Cognitive	Remembering Analyzing
CO2	***Explain, Design*** and ***Apply*** FIR digital filters	Cognitive	Understanding Applying, Evaluating
CO3	***Explain, Design*** and ***Apply*** IIR digital filters	Cognitive	Understanding Applying, Evaluating
CO4	***Define*** and ***Classify*** Finite word length	Cognitive	Remembering, Understanding Evaluating
CO5	***Define*** and ***Classify*** the hardware architecture, construct and ***justify*** signal processing modules in hardware	Cognitive	Understanding, Applying, Analyzing

UNIT I - DISCRETE FOURIER TRANSFORM **9 Hours**

Introduction to DSP and its applications – Efficient computation of DFT, Properties of DFT , FFT algorithms – Radix-2, Radix-4 FFT algorithms – Decimation in Time – Decimation in Frequency algorithms –Use of FFT algorithms in Linear Filtering and correlation. Convolution –overlap save and overlap add method.

UNIT II - DIGITAL FIR FILTERS DESIGN	9 Hours
Amplitude and phase responses of FIR filters – Linear phase filters – Windowing techniques for design of Linear phase FIR filters – Rectangular, Hamming, Hanning, Blackman, Kaiser windows – frequency sampling techniques, Realization structures for FIR	
UNIT III - DIGITAL IIR FILTERS DESIGN	**9 Hours**
IIR Filters – Magnitude response – Phase response – group delay - Design of Low Pass Butterworth filters (low pass) - Bilinear transformation – prewarping, impulse invariant technique - Realization structures for IIR Filters, direct-cascade and parallel form.	
UNIT IV - FINITE WORD LENGTH EFFECTS	**9 Hours**
Fixed point and floating point number representations-comparison- Truncation and rounding errors- Quantization noise – derivation for quantization noise power - coefficient quantization error- product quantization error-over flow error – Roundoff noise power –- limit cycle oscillations due to product round off and overflow errors – signal scaling- analytical model of sample and hold operations.	
UNIT V - DIGITAL SIGNAL PROCESSORS	**9 Hours**
Introduction to DSP architecture – Harvard architecture - Dedicated MAC unit - Multiple ALUs, Advanced addressing modes, Pipelining, Overview of instruction set of TMS320C5X and C54X	

HOURS	LECTURE	PRACTICAL	TOTAL
	45	0	45

TEXT BOOKS

1. Alan V. Oppenheim, Ronald Schafer, "Discrete Time signal Processing", Pearson Education,3rd Edition, 2010.
2. John G Proakis, Dimtris G Manolakis,"Digital Signal Processing Principles, Algorithms and Application",4th Edition, PHI, 2007,
3. Louis Scharf ,"Statistical Signal Processing", Pearson Education,1991.
4. B.Venkataramani& M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application" ,TMH, 2002.

REFERENCES

1. Avtarsingh, S.Srinivasan, "DSP Implementation using DSP Microprocessor with Examples from TMS32C54XX", Thomson / Brooks Cole Publishers, 2003
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, "Digital Signal Processing", McGrawHill TMH,2000.
3. JohnyR.Johnson Introduction to Digital Signal Processing", Prentice Hall, 1984.
4. S.K.Mitra, "Digital Signal Processing- A Computer based approach", Tata McGraw Hill, New Delhi, 1998.

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1. http://nptel.ac.in/courses/117102060/ (Prof: S. C. Dutta Roy, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Delhi)
2. http://nptel.ac.in/courses/Webcourse- contents/IIT-KANPUR/Digi_Sign_Pro/ui/About-Faculty.html (Prof. Govind Sharma, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Kanpur)

Mapping Of Course Outcomes With Program Outcomes

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3	1	2	2	2			1	1	1	2		1
CO 2	2	2	2	2	2	2			1	1	1	2		1
CO 3	3	3	2	2	2	2			1	1	1	2		1
CO 4	3	2	2	2	3	2			1	1	1	2		1
CO 5	2	2	2	0	1	0			0	0	0	2		1
Total	13	12	9	8	10	8	0	0	4	4	4	10	0	5
Scaled Value	3	3	2	2	2	2	0	0	1	1	1	2	0	1

COURSE CODE	XEC508	L	T	P	C
COURSE NAME	ANALOG INTEGRATED CIRCUITS LAB	0	0	1	1
PREREQUISITE	Electronic Devices, Electronic Circuits				

C	P	A		L	T	P	H
1	0	0		0	0	2	2

LEARNING OBJECTIVES

- To familiarize the basics of linear integrated circuits and available ICs
- To impart the knowledge on the characteristics of the operational amplifier.
- To teach the applications of operational amplifiers.
- To give insight into the basic knowledge of special function IC

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	**Understand** the principles of differential amplifiers and hence operational amplifiers.	Cognitive Psychomotor	Understanding Mechanism
CO2	**Analyze** the working of operational amplifiers and basic applications.	Cognitive Psychomotor	Analyzing Understanding
CO3	**Apply** the principles of op-amp for various applications.	Cognitive	Applying
CO4	**Understand** the working of multivibrators, filters, schimitt trigger.	Cognitive	Understanding
CO5	**Understand** and carry out the working of specialized ICs.	Cognitive Psychomotor	Understanding Mechanism

LIST OF EXPERIMENTS (Discrete Components and Simulation)

S.No	List of Experiments	COs
1	Familiarization of Operational amplifiers - Inverting and Non inverting amplifiers, frequency response, Adder, Integrator, comparators.	CO1
2	Measurement of Op-Amp parameters.	CO1
3	Difference Amplifier and Instrumentation amplifier.	CO2
4	Schmitt trigger circuit using Op –Amps	CO2
5	Precision rectifiers using Op-Amp	CO3
6	RC Phase shift and Wien bridge oscillator using Op-Amp	CO3
7	Colpitts and Hartley Oscillator using Op –Amps	CO4
8	Astable , Bistable and Monostable multivibrators using IC 555 Timer	CO4
9	Active second order filters using Op-Amp (LPF, HPF, BPF and BSF).	CO4
10	A/D converters	CO5
11	D/A Converters	CO5
12	Study of PLL IC: free running frequency lock range capture range	CO5
	Mini Project: Application of Op- amp for Electronic Design	

	PRACTICAL	TUTORIAL	TOTAL
HOURS	30	0	30

TEXT BOOKS
1. Franco S., Design with Operational Amplifiers and Analog Integrated Circuits, 4/e, Tata McGraw Hill, 2015 2. Salivahanan S. ,V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008
REFERENCES
1. Botkar K. R., Integrated Circuits, 10/e, Khanna Publishers, 2010 2. A. Bell, Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition, 2010 3. Gayakwad R. A., Op-Amps and Linear Integrated Circuits, Prentice Hall, 4/e, 2010
E REFERENCES
1. https://nptel.ac.in/courses/108106068/

Mapping of COs with POs:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	3	3		2	1				2	2		1		
CO 2	3	3		2	1				2	2		1		
CO 3	3	3		2	1				3	2		1		
CO 4	1	2		2	1				2	2		1		
CO 5	1	2		2	1				2	2		1		
Total	11	13		10	5				11	10		5		
Scaled Value	3	3		2	1				3	2		1		

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE	XEC509	L	T	P	C
COURSE NAME	ANALOG AND DIGITAL COMMUNICATION LAB	0	0	1	1
PREREQUISITES	Communication Theory Digital Communication	L	T	P	H
C:P:A	1:0:0	0	0	2	2

LEARNING OBJECTIVES

- To introduce the different types of analog and digital modulation and demodulation
- To convey frequency division multiplexing and demultiplexing
- To expose the students line coding and decoding.
- To create awareness on the performance of digital modulation techniques in AWGN and Rayleigh channels

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Measure*** Amplitude Modulation, Demodulation, sensitivity and selectivity of AM receivers and Frequency Division	Psycomotor	Mechanism
CO2	***Construct*** Frequency Modulation, Demodulation, sensitivity and selectivity of FM receivers.	Psycomotor	Complex overt response
CO3	***Trace*** Frequency Division Multiplexing	Psycomotor	Guided Response
CO4	***Display*** various types of analog and digital Pulse Modulations using trainer kits.	Psycomotor	Set
CO5	***Show*** performance of digital modulation techniques in AWGN and Rayleigh channels.	Psycomotor	Set

S.No	List of Experiments	COs
1	i) Amplitude Modulation and Demodulation using Kit. ii) DSB FC, DSB SC, SSB SC spectrum using Matlab software iii) Performance of AM receiver (Selectivity & Sensitivity) using Kit	CO1
2	i) Frequency Modulation and Demodulation using Kit and Matlab software ii) Performance of AM receiver (Selectivity & Sensitivity) using Kit	CO2
3	Frequency Division Multiplexing	CO3
4	i) Sampling and Reconstruction ii) PAM/PWM/PPM modulation and Demodulation using kit	CO4
5	i) PCM and DPCM modulation and demodulation using kit ii) Delta modulation and Demodulation using kit	CO4
6	ASK, FSK, PSK and QPSK modulation using Kit	CO4
7	Demonstration of theoretical and simulated BER for M-PSK, M- QAM in AWGN using MATLAB	CO5
8	BER for BPSK/QPSK/QAM under Rayleigh channel	CO5
9	BER performance of BPSK using convolutional code under AWGN channel	CO5
10	Demonstration of Direct Sequence Spread Spectrum in AWGN	CO5

HOURS	TUTORIAL	PRACTICAL	TOTAL
	0	30	30

TEXT BOOKS

1. JOHN W. LEIS, "Communication Systems Principles Using MATLAB" 1st Edition, Wiley, 2018.
2. Kwonhue Choi and Huaping Liu, "Problem-Based Learning in Communication Systems Using MATLAB and Simulink (IEEE Series on Digital & Mobile Communication)" 1st Edition, Wiley-IEEE Press, 2016

REFERENCES

1. Amplitude Modulation Transmitter and Receiver User Manual, ACLT 001, United Electrotechnologies, Bangalore
2. Frequency Modulation Transmitter and Receiver User Manual,United Electrotechnologies, Bangalore
3. Pulse Modulation Trainer PAM/PWM/PPM DCT 007 User Manual,United Electrotechnologies, Bangalore
4. Channel Encode/Decode DCL -00 & DCL User Manual, Khodayss Systems Limited, Bangalore
5. Sampling and Reconstruction Unit DCLT001 User Manual, United Electrotechnologies, Bangalore
6. Pulse Code Modulation & Demodulation (Model No: VCT -07) User Manual, Vi Microsystems PVT Ltd, Chennai
7. Delta PCM Trainer (Model No: VCT -12) User Manual, Version 2.0, Vi Microsystems PVT Ltd, Chennai
8. Differential PCM Trainer (VCT – 34) User Manual Version 1.0, Vi Microsystems PVT Ltd, Chennai
9. TDM, PAM Modulation and Demodulation User Manual Version 1.0, Vi Microsystems PVT Ltd, Chennai

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	2	2	1	1	2	1	1	1	2	2	1	1		2
CO 2	2	2	1	1	2	1	1	1	2	2	1	1		2
CO 3	2	2	1	1	2	1	1	1	2	2	1	1		2
CO 4	2	2	1	1	2	1	1	1	2	2	1	1		2
CO 5	2	2	1	1	2	1	1	1	2	2	1	1		2
Total	10	10	5	5	10	5	5	5	10	10	5	5		10
Scaled Value	2	2	1	1	2	1	1	1	2	2	1	1		2

COURSE CODE			XEC510	L	T	P	C
COURSE NAME			DIGITAL SIGNAL PROCESSING LABORATORY	0	0	1	1
PREREQUISITES				L	T	P	H
C	P	A		0	0	2	2
1	0	0					

LEARNING OBJECTIVES

- To compute the output response of the system for FFT spectrum.
- To make the students understand the behavior and response of the filter using different methods.
- To educate the students with the generation of the signals and arithmetic operation using DSP Processor

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Computation*** of linear and circular convolution	Cognitive Psychomotor Affective	Mechanism Responding
CO2	***Design*** of digital IIR digital filters.	Cognitive Psychomotor Affective	Mechanism Responding
CO3	***Design*** of digital FIR digital filters.	Cognitive Psychomotor Affective	Mechanism Responding
CO4	***Define*** and ***Classify*** the hardware architecture, construct and ***justify*** signal processing modules in hardware	Cognitive Psychomotor Affective	Mechanism Responding
CO5	Design of varies projects	Cognitive Psychomotor Affective	Mechanism Responding

USING MATLAB®/SCILAB® & TMS320C5X		
S.No	**List of Experiments**	**COs**
1.	Generation of signals(Analog & Digital) (Using SciLab)	CO1
2.	Convolution of two sequences. (Using SciLab)	CO1
3.	Calculation of DFT and IDFT of a signal. (Using SciLab)	CO1
4.	Calculation of FFT and IFFT of a signal. (Using SciLab)	CO1
5.	Design of IIR filters. (Using SciLab)	CO2
6.	Design of FIR filters. (Using SciLab)	CO3
7.	Sine Wave generation (Using TMS320C5X)	CO1&CO5
8.	Convolution of two sequences (Using TMS320C5X)	CO1&CO5
9.	Calculation of DFT(Using TMS320C5X)	CO1&CO5
10.	Calculation of FFT(Using TMS320C5X)	CO1&CO5
11.	Implementation of IIR filter (Using TMS320C5X)	CO2&CO5
12.	Implementation of FIR filter (UsingTMS320C5X)	CO3&CO5

HOURS	**TUTORIAL**	**PRACTICAL**	**TOTAL**
	0	**20**	**20**

TEXT BOOKS
1. B.Venkataramani& M. Bhaskar, "Digital Signal Processor Architecture, Programming and Application" ,TMH, 2002.
REFERENCES
1. Avtarsingh, S.Srinivasan, "DSP Implementation using DSP Microprocessor with Examples from TMS32C54XX", Thomson / Brooks Cole Publishers, 2003
E-REFERENCES
1. http://nptel.ac.in/courses/117102060/ (Prof: S. C. Dutta Roy, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Delhi) 2. http://nptel.ac.in/courses/Webcourse- contents/IIT-KANPUR/Digi_Sign_Pro/ui/About-Faculty.html (Prof. Govind Sharma, "Digital Signal Processing, Nptel online courses", Department of Electrical Engineering, Indian Institute of Technology, Kanpur)

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	3		2	1				2	2		1		
CO 2	3	3		2	1				2	2		1		
CO 3	3	3		2	1				3	2		1		
CO 4	1	2		2	1				2	2		1		
CO 5	1	2		2	1				2	2		1		
Total	11	13		10	5				11	10		5		
Scaled	3	3		2	1				3	2		1		

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSECODE			XECM01	L	T	P	C
COURSE NAME			PCB DESIGN THROUGH ULTIBOARD	0	0	0	0
PREREQUISITE							
C	P	A		L	T	P	H
0	0	0		0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** Printed Circuit Boards and ***design*** them using a CAD software.	Cognitive Psychomotor	Remember Complex Over Response

PCB characteristics- Materials - Laminates - Key Substrates- PCB design steps- Subtractive, additive and semi-additive processes- Chemical etching - drilling - coating - Creating a Board Outline- Placing Components - Dragging Components from Outside the Board Outline Dragging Components from the Parts Tab - Placing the Tutorial Components- Placing Parts from the Database - Moving Components Placing Traces-About Component Connections - Options for Placing Traces Placing a Manual Trace -Placing a Follow-me Trace Placing a Connection Machine Trace Net Bridges - PCB Transmission Line Calculator - PCB Differential Impedance Calculator -Preparing for Manufacturing/Assembly Cleaning up the Board - Adding Comments - Exporting a File- Viewing Designs in 3D

HOURS	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	5	0	10	15

TEXT BOOKS

1. National Instruments, "Ultiboard 9 PCB Layout User Guide", http://www.ni.com/pdf/manuals/371586b.pdf, 11500 North Mopac Expressway Austin, Texas 78759-3504 USA Tel: 512 683 0100, 2003–2006
2. Clyde Coombs and Happy Holden , "Printed Circuits Handbook, McGraw-Hill Education; 7 edition, 2016.

VI – SEMESTER

COURSECODE			XEC602	L	T	P	C
COURSE NAME			CONTROL SYSTEMS	3	0	0	3
PREREQUISITE			Maths				
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES:

- To impart the knowledge to the students with the basic concept of control system
- To emphasis the students with the behaviour of system on time domain and frequency domain
- To educate the students with the knowledge on compensators and controllers.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Outline*** and ***explain*** the mathematical modeling of electrical and mechanical systems.	Cognitive	Remembering, Understanding
CO2	***Describe*** and ***apply*** Time domain analysis methods and ***interpre*t** the stability of the systems.	Cognitive	Remembering, Applying, Understanding
CO3	***Describe*** and apply Frequency domain analysis methods and ***interpret*** the stability of the systems.	Cognitive	Remembering, Applying, Understanding
CO4	***Explain***, ***solve*** and ***justify*** compensation techniques and controllers	Cognitive	Understanding, Applying, Evaluate
CO5	***Outline*** and ***illustrate*** various electrical and mechanical systems through control systems.	Cognitive	Remembering, Understanding

UNIT I - CONTROL SYSTEM MODELLING	**(9 Hours)**
System concept, differential equations and transfer functions. Modelling of electric systems, translational and rotational mechanical systems, Simple electromechanical systems.Block diagram representation of systems – Block diagram reduction methods – Closed loop transfer function, determination of signal flow graph. Mason's gain formula – Examples.	
UNIT II - TIME DOMAIN ANALYSIS	**(9 Hours)**
Test signals – time response of first order and second order systems – time domain specifications – types and order of systems – generalised error coefficients – steady state errors – concepts of stability – Routh-Hurwitz stability – root locus.	
UNIT III - FREQUENCY DOMAIN ANALYSIS	**(9 Hours)**
Introduction – correlation between time and frequency response – stability analysis using Bode plots, Polar plots, Nichols chart and Nyquist stability criterion – Gain margin – phase margin- Examples in Matlab	
UNIT IV – COMPENSATORS	**(9 Hours)**
Realization of basic compensators – cascade compensation in time domain and frequency domain and feedback compensation – design of lag, lead, lag-lead compensator using Bode plot and Root locus. Introduction to P, PI and PID controllers, Introduction to fuzzy controllers.	
UNIT V - CONTROL SYSTEM COMPONENTS AND APPLICATION OF CONTROL SYSTEMS	**(9 Hours)**
Stepper motors – AC servo motor – DC servo motor – Synchros – sensors and encoders – DC tacho generator – AC tacho generator – Hydraulic controller – Pneumatic controller – Typical application of control system in industry- Aviation- High precision machines- CNC machines, Case study on Control system in Safety and environmental .	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOK

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw- Hill,2012.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 2014.

REFERENCES

1. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 2012.
2. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi,2013

E REFERENCES

1. http://webx.ubi.pt/~felippe/texts/contr_systems_ppt07e.pdf
2. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control-systems-fall-2010/lecture-notes/MIT16_30F10_lec03.pdf
3. http://www.electrical4u.com/compensation-in-control-system-lag-lead-compensation/
4. http://www.electrical4u.com/bode-plot-gain-margin-phase-margin/
5. https://www.youtube.com/watch?v=zGr_LS6OToE
6. https://www.youtube.com/watch?v=QJNAZ86rKlk
7. https://www.youtube.com/watch?v=RMwSnHRMjOY
8. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur /Industrial% 20Automation%20control/pdf/L(SS)%20(IA&C)%20((EE)NPTEL).pdf
9. http://www.bput.ac.in/lecture_notes/Control_System.pdf

Mapping of COs with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PS O 2
CO 1	3	2				1				2		1		
CO 2	3	2				2						2		
CO 3	3	2		2	3	2				3		2		
CO 4	3	2				2						2		
CO 5	3	2	3			3	2	2	2	2		1		
Total	15	10	3	2	3	10	2	2	2	7		8		
Scaled value	3	2	1	1	1	2	1	1	1	2		2		

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSE CODE			XEC603	L	T	P	C
COURSE NAME			ANTENNAS AND WAVE PROPAGATION	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To give insight into the radiation phenomena.
- To give a thorough understanding of the radiation characteristics of different types of antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe, explain and determine the*** parameters of antennas.	Cognitive	Remembering, Understanding,
CO2	***Classify and Explain antenna*** arrays and loop antennas.	Cognitive	Remembering, Understanding ,
CO3	***Describe the operation of Travelling wave antenna sand special antennas***	Cognitive	Remembering, Understanding ,
CO4	***Illustrate*** the radiation characteristics of aperture and lens antennas.	Cognitive	Remembering, Understanding ,
CO5	***Outline*** and narrate the methods of wave propagation and associated parameters.	Cognitive	Remembering, Understanding

UNIT I - ANTENNA FUNDAMENTALS **(9 Hours)**

Concept of vector potential. Modification for time varying retarded case. Fields associated with Hertzian dipole. Power radiated and radiation resistance of current element. Radiation resistance of elementary dipole with linear current distribution.

Definitions: Radiation intensity. Directive gain. Directivity. Power gain. Beam Width. Band Width. Gain and radiation resistance of current element. Half-wave dipole and folded dipole. Reciprocity principle. Effective length and Effective area. Relation between gain effective length and radiation resistance.

UNIT II - ELECTRIC DIPOLES, ANTENNA ARRAYS AND LOOP ANTENNAS	(9 Hours)
Radiation from half-wave dipole and quarter-wave monopole. Assumed current distribution for wire antennas. Use of capacity hat and loading coil for short antennas. Antenna Arrays: Electric field from two and three element arrays. Uniform linear array. Method of pattern multiplication. Binomial array. Use of method of images for antennas above ground. Loop Antennas: Radiation from small loop and its radiation resistance. Radiation from a loop with circumference equal to a wavelength and resultant circular polarization on axis. Helical antenna. Normal and axial mode operation.	
UNIT III - TRAVELLING WAVE ANTENNAS AND SPECIAL ANTENNAS	**(9 Hours)**
Radiation from a travelling wave on a wire. Analysis of Rhombic antenna. Design of Rhombic antennas. Coupled Antennas: Self and mutual impedance of antennas. Yagi antennas. Log periodic antenna. Reason for feeding from end with shorter dipoles and need for transposing the lines. Antenna for Special Applications: Sleeve antenna, Turnstile antenna, Spiral antenna, Helical antenna, Reconfigurable antenna, Dielectric antennas, Electronic band gap structures and applications. Microstrip antennas	
UNIT IV – APERTURE AND LENS ANTENNAS	**(9 Hours)**
Radiation from an elemental area of a plane wave (Huygen's Source). Radiation from the open end of a coaxial line. Radiation from a rectangular aperture treated as an array of Huygen's sources. Equivalence of fields of a slot and complementary dipole. Relation between dipole and slot impedances. Method of feeding slot antennas. Thin slot in an infinite cylinder. Horn antennas, dish antennas. Dielectric lens and metal plane lens antennas. Luneburg lens. Spherical waves , Biconical antenna and smart antenna- Switched beam and adaptive array.	
UNIT V - WAVE PROPAGATION	**(9 Hours)**
Modes of propagation , Structure of atmosphere , Ground wave propagation , Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation	

	LECTURE	TUTORIAL	TOTAL
	45	0	45

TEXT BOOK
1. Balanis, "Antenna Theory ", 2nd Edition, John Wiley & Sons, 2003. 2. Edward C.Jordan and Keith G.Balmain, “Electromagnetic Waves and Radiating Systems” Prentice Hall of India, 2006. 3. John D Kraus,” Antennas for all Applications”, 3rd Edition, Mc Graw Hill, 2005.
REFERENCES
1. John D.Kraus and Ronalatory Marhefka, "Antennas For All Applications", 3rd Edition, Tata McGrawHill, 2003. 2. R.E.Collins, “Antennas and Radio Propagation ", McGraw-Hill, 1987. 3. Constantine. A.Balanis “Antenna Theory Analysis and Design”, Wiley Student Edition, 2006. 4. Rajeswari Chatterjee, “Antenna Theory and Practice” Revised Second Edition, New Age International Publishers, 2006. 5. S. Drabowitch, “Modern Antennas”, 2nd Edition, Springer Publications, 2007. 6. Robert S.Elliott “Antenna Theory and Design” Wiley Student Edition, 2006. 7. H.Sizun “Radio Wave Propagation for Telecommunication Applications”, First Indian Reprint, Springer Publications, 2007.
E- REFERENCES
1. http://nptel.ac.in/courses/117101056/48 (NPTEL: Prof R.K.Shevgaonkar, Transmission Lines and E.M. Waves)

Mapping of COs with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	2	2	2	2	1	1					1		2
CO 2	3	2	2	2	2	1	1					1		2
CO 3	3	2	2	2	2	1	1					1		2
CO 4	3	2	2	2	2	1	1					1		2
CO 5	3	2	2	2	2	1	1					1		2
Total	14	5	2	9	9							5		
Scaled Value	3	1		2	2							1		1

0- No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSECODE			XEC607	L	T	P	C
COURSE NAME			VLSI DESIGN AND EMBEDDED SYSTEMS	3	0	0	3
PREREQUISITES			Microprocessors and Microcontrollers				
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To enrich students with the knowledge of IC fabrication techniques
- To provide students with a solid foundation on combinational and sequential circuits using Verilog .
- To expose the students on embedded system design and development
- To provide students with the software and hardware concept of processor in real time environment.
- To develop an understanding on the basic concepts of the peripherals in embedded systems.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Outline***, ***explain*** the IC fabrication techniques, design rules pertaining to CMOS technology and ***construct and report the*** design of logic gates .	Cognitive Affective	Remembering, Understanding
CO2	***Design***, ***create, construct and report the*** combinational and sequential circuits using Verilog	Cognitive Affective	Analyze, Create
CO3	***Describe, understand***, ***construct and report*** embedded system design and development	Cognitive Affective	Remembering, Understanding, Applying
CO4	***Describe***, ***understand, react*** *and* ***perform*** *the* software and hardware concept of processor in real time environment.	Cognitive Affective	Remembering, Understanding
CO5	***Define***, ***select, compare, reproduce and identify*** the peripherals in embedded systems.	Cognitive Affective	Remembering, Understanding, Evaluate

UNIT I - CMOS TECHNOLOGY	(9 Hours)
An overview of Silicon semiconductor technology, Basic CMOS technology: well, P well, Twin tub and SOI Process. Interconnects, circuit elements: Resistors, capacitors, Electrically alterable ROMs, bipolar transistors, Latch up and prevention. Layout design rules, physical design: basic concepts, physical design of logic gates: Inverter, NAND, NOR, Design Hierarchies. Review of MOS transistor models. CMOS logic families including static, dynamic and dual rail logic, i.e., Parallel & Series Equivalent circuits; Static CMOS Circuit Design, High Speed Dynamic CMOS logic families; Precharge-Evaluate logic; Dynamic CMOS logic circuits, cascading, charge sharing and clock distribution.	
UNIT II - SPECIFICATION USING VERILOG HDL and VHDL	**(9 Hours)**
Basic Concepts: VLSI Design flow, identifiers, gate primitives, value set, ports, gate delays, structural gate level and switch level modeling, Design hierarchies, Behavioral and RTL modeling: Operators, timing controls, Procedural assignments conditional statements, Data flow modeling and RTL. Structural gate level description of decoder, equality detector, comparator, priority encoder, D-latch, D-ff, half adder, Full adder, Ripple Carry adder, Programming of PALs,ASIC design flow. Design methodology: Introduction to hardware description languages (VHDL), logic, circuit, and layout verification. Design examples.	
UNIT III - INTRODUCTION TO EMBEDDED SYSTEMS AND DESIGN ANALYSIS	**(9 Hours)**
Complex systems and microprocessors – Embedded system design process – Formalism for system design-ARM processor – Architecture, Instruction sets and programming. CPU: Programming input and output – Coprocessor – Memory system mechanism– Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.	

UNIT IV - PROCESSES,OPERATING SYSTEMS AND EMBEDDED SOFTWARE	(9 Hours)
Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Performance issues-Programming embedded systems in assembly and C – Meeting real time constraints –Multi-state systems and function sequences. Embedded software development tools –Emulators and debuggers.	
UNIT V - DEVICES AND BUSES FOR DEVICES NETWORK	**(9 Hours)**
I/O devices – device I/O types and examples – synchronous – Iso-synchronous and asynchronous communications from serial devices – examples of internal serial – communication devices – UART and HDLC – parallel port devices – sophisticated interfacing features in devices/ports – timer and counting devices – '12C', 'USB', 'CAN' and advanced I/O serial high speed buses – ISA, PCI, PCIX, CPCI and advanced buses.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOK

1. Frank Vahid and Tony Givargis, "Embedded System Design", 3rd Edition, Wiley India, 2002.
2. Arnold S. Berger "Embedded Systems Design", 1st Edition, Taylor & Francis, 2002.
3. Rajkamal "Embedded Systems", 2nd Edition, Tata McGraw Hill, 2008.
4. A. Pucknell and Kamran Eshraghian, "Basic VLSI Design", 3rd Edition,PHI,1995.
5. K. Lal Kishore, V.S.V. Prabhakar, "VLSI Design", I.K. International Pvt.Ltd, 2010.
6. Neil H.E Weste, David Money Harris, "CMOS VLSI Design",3rd Edition, Pearson Education, 2005.
7. Neil weste and Kamran Eshraghian "Principles of CMOS VLSI Design – A Systems Perspective", 2nd Edition, Pearson Education, Reprint 2010.
8. Principles of CMOS VLSI Design, Addison Wesley N. Weste and K. Eshranghia Addison Wesley. 1985
9. The Design and Analysis of VLSI Circuits, L. Glaser and D. Dobberpuhl ,Addison Wesley,1985
10. Introduction to VLSI Systems ,C. Mead and L. Conway ,Addison Wesley1979
11. Digital Integrated Circuits: A Design Perspective, J. Rabaey, Prentice Hall India, 1997
    5.VHDL ,D. Perry, McGraw Hill International 1995 2nd Ed.,

REFERENCES

1. David Kleidermacher, Mike Kleidermacher, "Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development", PHI, 2012.
2. Chattopadhyan, "Embedded System Design", 3rd Edition, PHI,2013.
3. M.J.S.Smith: "Application Specific integrated circuits", Pearson Education, 1997.
4. Wayne Wolf, "Modern VLSI Design", Pearson Education, 2003.
5. Bob Zeidmin "Introduction to verilog", Prentice Hall, 1999.
6. J .Bhaskar, "Verilog HDL Primer", Prentice Hall, 1999.
7. E. Fabricious, "Introduction to VLSI design", McGrawHill, 1990.
8. C. Roth, "Digital Systems Design Using VHDL", Thomson Learning, 2000.

E-REFERENCES

1. http://web.cs.mun.ca/~paul/transistors/node3.html
2. http://www.csee.umbc.edu/~cpatel2/links/315/lectures/chap3_lect09_processing2.pdf
3. http://www.aicdesign.org/scnotes/2002notes/Chapter02-2UP(8_13_02).pdf
4. www.verilog.com
5. http://www.ece.umd.edu/class/enee359a/verilog_tutorial.pdf
6. https://www.vidyarthiplus.com/vp/attachment.php?aid=24159
7. https://www.vidyarthiplus.com/vp/attachment.php?aid=20222
8. http://ic.sjtu.edu.cn/ic/dic/wp-content/uploads/sites/10/2013/04/CMOS-VLSI-design.pdf
9. https://swayam.gov.in/course/3573-embedded-systems-design

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2										1		
CO 2	2	2								2		1		
CO 3	2	2							2			1		
CO 4	2	2								2		1		
CO 5	2	2							2			1		
Total	10	10							4	4		5		
Scaled Value	2	2							1	1		1		

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSECODE			XEC608	L	T	P	C
COURSE NAME			VLSI DESIGN AND EMBEDDED SYSTEMS LAB	0	0	1	1
PREREQUISITE			VLSI Design and Embedded Systems				
C	P	A		L	T	P	H
1	0	0		0	0	2	2

LEARNING OBJECTIVES

- To acquaint the students with the the concept of FGPA and construct the FPGA circuits.
- To give insight to the students to develop the codes for the circuit using verilog.
- To emphasis the students with the design and develop the software and hardware concept of processor in real time environment.
- To equip the students with the serial communication port ,RTOS on embedded systems
- To inculcate the understanding of interfacing of data I/O devices with embedded systems in real time and use the peripherals in embedded systems.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Understand*** the concept of FGPA and ***construct*** the FPGA circuits.	Cognitive, Psychomotor	Understanding, Analyzing
CO2	***Define, select*** and ***develop*** the codes for the circuit using verilog.	Cognitive, Psychomotor	Remembering, Understanding
CO3	***Describe, understand,*** and ***construct*** the embedded system design and **develop** the software and hardware concept of processor in real time environment.	Cognitive, Psychomotor	Remembering, Understanding
CO4	***Describe and understand*** the serial communication port ,RTOS on embedded systems	Cognitive, Psychomotor	Remembering, Understanding
CO5	***Understand*** the interfacing of data I/O devices with embedded systems in real time and use the peripherals in embedded systems.	Cognitive, Psychomotor	Analyzing, Understanding

S.No	List of Experiment	COs
1	Display the text in 2 x16 LCD using FPGA.	CO1
2	Study of simulation and synthesis for Logic Gates	CO1
3	Study of simulation and synthesis, place, root and back annotation for FPGAs	CO2
4	Study and implementation of schematic entry and Verilog code simulation of pipelined serial and parallel adder to add/subtract 8 number of size, 12 bit each in 2's complement.	CO2
5	Implementation of LEDs blinking controlled by switches using Verilog codes for Combinational circuits.	CO3
6	Implementation of LEDs blinking controlled by switches using Verilog codes for Sequential circuits.	CO3
7	Interfacing the LED using ARM Development board .	CO4
8	Interfacing to Input/output Devices (keyboard and LCD) using ARM Development board.	CO4
9	Serial communication using I2C with ARM Development Board.	CO4
10	Interfacing the stepper motor/servo motor/DC with ARM cortex board.	C05
11	Interfacing EPROM and interrupt with ARM cortex board.	CO5
12	Interfacing the ADC and DAC with ARM cortex board.	CO5
	Miniproject – Application of embedded systems on health, safety, environment	

PRACTICAL	TUTORIAL	TOTAL
30	0	30

TEXT BOOKS

1. Frank Vahid and Tony Givargis, "Embedded System Design", 3rd Edition, Wiley India, 2002.
2. Arnold S. Berger "Embedded Systems Design", 1st Edition, Taylor & Francis, 2002.
3. Rajkamal "Embedded Systems", 2nd Edition, Tata McGraw Hill, 2008.
4. A. Pucknell and Kamran Eshraghian, "Basic VLSI Design", 3rd Edition,PHI,1995.
5. K. Lal Kishore, V.S.V. Prabhakar, "VLSI Design", I.K. International Pvt.Ltd, 2010.
6. Neil H.E Weste, David Money Harris, "CMOS VLSI Design",3rd Edition, Pearson Education, 2005.
7. Neil weste and Kamran Eshraghian "Principles of CMOS VLSI Design – A Systems Perspective", 2nd Edition, Pearson Education, Reprint 2010.
8. Principles of CMOS VLSI Design, Addison Wesley N. Weste and K. Eshranghia Addison Wesley. 1985
9. The Design and Analysis of VLSI Circuits, L. Glaser and D. Dobberpuhl ,Addison Wesley,1985
10. Introduction to VLSI Systems ,C. Mead and L. Conway ,Addison Wesley1979
11. Digital Integrated Circuits: A Design Perspective, J. Rabaey, Prentice Hall India, 1997 5. VHDL ,D. Perry, McGraw Hill International 1995 2nd Ed.,

REFERENCES

1. David Kleidermacher, Mike Kleidermacher, "Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development", PHI, 2012.
2. Chattopadhyan, "Embedded System Design", 3rdEdition, PHI,2013.
3. M.J.S.Smith: "Application Specific integrated circuits", Pearson Education, 1997.
4. Wayne Wolf, "Modern VLSI Design", Pearson Education, 2003.
5. Bob Zeidmin "Introduction to verilog", Prentice Hall, 1999.
6. J .Bhaskar, "Verilog HDL Primer", Prentice Hall, 1999.
7. E. Fabricious, "Introduction to VLSI design", McGrawHill, 1990.
8. C. Roth, "Digital Systems Design Using VHDL", Thomson Learning, 2000.

E REFERENCES

1. http://web.cs.mun.ca/~paul/transistors/node3.html
2. http://www.csee.umbc.edu/~cpatel2/links/315/lectures/chap3_lect09_processing2.pdf
3. http://www.aicdesign.org/scnotes/2002notes/Chapter02-2UP(8_13_02).pdf
4. www.verilog.com
5. http://www.ece.umd.edu/class/enee359a/verilog_tutorial.pdf
6. https://www.vidyarthiplus.com/vp/attachment.php?aid=24159
7. https://www.vidyarthiplus.com/vp/attachment.php?aid=20222
8. http://ic.sjtu.edu.cn/ic/dic/wp-content/uploads/sites/10/2013/04/CMOS-VLSI-design.pdf
9. https://swayam.gov.in/course/3573-embedded-systems-design
10. http://www.keil.com/dd/docs/data

Mapping of COs with POs:

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	3	2	1	3	3	3	1		3	3	2	3		
CO 2	3	1	1	3	3	3	1		3	3	2	3		
CO 3	2	1	1	3	3	3	1		3	3	2	3		
CO 4	2	1	1	3	3	3	1		3	3	2	3		
CO 5	2	2	1	3	3	3	1		3	3	2	3		
Total	12	7	1	15	15	15	5		15	15	10	15		
Scaled Value	3	2	1	3	3	3	1		3	3	2	3		0

0 - No Relation 1 - Low Relation , 2 – Medium Relation, 3- High Relation

COURSECODE			XECM02	L	T	P	C
COURSE NAME			PLC AND SENSORICS	0	0	0	0
PREREQUISITE			XEC 304				
C	P	A		L	T	P	H
0	0	0		0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** the role of PLC and sensorics in Industrial Automation and ***integrate them*** using Indra logic software.	Cognitive Psychomotor	Remember Complex Overt Response

PLC architecture (L20DB) – ladder language coding for basic logic gates – AND,OR,NOR,NAND – user defined functions – Up counter, down counter, TON,TOFF ,Rising trigger, Falling trigger –sub program concept, set and reset concept-program for given case study (Ex:Traffic light signal control, Bottling etc) – Interfacing of PLC with hardware using communication parameter.

Sensorics-Construction and working principle of Inductive sensor, Capacitive sensor, Photo electric sensor, Ultrasonic sensor and Proximity sensor – study of characteristics of each sensor with respect to the sample material-interfacing of sensors with PLCs

	LECTURE	PRACTICAL	TOTAL
	5	10	15

TEXT BOOKS

1. Kelvin.T.Ericson , “Programmable Logic Controllers: An Emphasis on Design and Application”, 2nd Edition, 2011
2. Handbook on PLC and Sensorics –Bosch Rexroth .
3. Krzysztof Iniewski , “Smart Sensors for Industrial applications”, 2017 CRC Press

COURSE CODE			XEC702	L	T	P	C
COURSE NAME			MICROWAVE ENGINEERING AND FIBRE OPTIC COMMUNICATION	3	0	0	3
PREREQUISITES			Communication Theory	L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To instill the knowledge on the Microwave frequencies and applications of microwave communication
- To familiarize microwave components of microwave systems.
- To provide exposure to the students on the operation and working microwave tubes and sources for the transmission of the microwave frequencies
- To emphasis the students with the knowledge the measurement of various parameters of microwave systems.
- To acquire the basic knowledge of optical sources, detectors and optical communication system
- To educate the students on various coupling techniques

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe, demonstrate and analyze*** the parameters of passive microwave components.	Cognitive	Understanding
CO2	***Describe, assemble, demonstrate, measure and analyze*** the parameters of microwave sources and construct microwave bench.	Cognitive	Understanding
	Outline, assemble and distinguish various semiconductor devices.	Cognitive	Understanding
CO4	***Explain, assemble, measure and analyze*** the transmission characteristics of optical fibers.	Cognitive	Understanding
CO5	***Explain, identify and measure*** the characteristics of optical sources and detectors.	Cognitive	Understanding

UNIT I - MICROWAVE PASSIVE COMPONENTS	(9 Hours)
Microwave frequency range, significance of microwave frequency range - applications of microwaves. Scattering matrix -Concept of N port scattering matrix representation. Properties of S matrix- S matrix formulation of two-port junction. Microwave junctions - Tee junctions -Magic Tee - Rat race - Corners - bends and twists - Directional couplers - two hole directional couplers- Ferrites - important microwave properties and applications – Termination - Gyrator- Isolator-Circulator - Attenuator - Phase changer – S Matrix for microwave components – Cylindrical cavity resonators.	
UNIT II - MICROWAVE TUBES AND MEASUREMENTS	**(9 Hours)**
Microwave tubes- High frequency limitations - Principle of operation of Multicavity Klystron, Reflex Klystron, Traveling Wave Tube, Magnetron. Microwave measurements: Measurement of power, wavelength, impedance, SWR, attenuation, Q and Phase shift.	
UNIT III - MICROWAVE SEMICONDUCTOR DEVICES	**(9 Hours)**
Microwave semiconductor devices- operation - characteristics and application of BJTs and FETs - Principles of tunnel diodes - Varactor and Step recovery diodes - Transferred Electron Devices - Gunn diode- Avalanche Transit time devices- IMPATT and TRAPATT devices. Parametric devices -Principles of operation - applications of parametric amplifier .Microwave monolithic integrated circuit (MMIC) - Materials and fabrication techniques.	
UNIT IV - TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS AND COMPONENTS	**(9 Hours)**
Introduction, Ray theory transmission- Total internal reflection-Acceptance angle – Numerical aperture – Skew rays – Electromagnetic mode theory of optical propagation – EM waves – modes in Planar guide – phase and group velocity – cylindrical fibers – SM fibers. Attenuation – Material absorption losses in silica glass fibers – Linear and Non linear Scattering losses - Fiber Bend losses – Intra and inter Modal Dispersion – Over all Fiber Dispersion –	

Polarization- non linear Phenomena. Optical fiber connectors, Fiber alignment and Joint Losses – Fiber Splices – Fiber connectors – Expanded Beam Connectors – Fiber Couplers.

UNIT V - SOURCES ,TRANSMITTER AND DETECTORS, FIBER OPTIC RECEIVER	**(9 Hours)**

Optical sources: Light Emitting Diodes - LED structures - surface and edge emitters, mono and hetero structures, LASER , Comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes , Optical Transmitter, Receiver

	LECTURE	**PRACTICAL**	**TOTAL**
	45	**0**	**45**

TEXT BOOKS

1. Samuel Y. Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.
2. John M. Senior, "Optical Fiber Communication", 2nd Edition, Pearson Education, 2007.
3. Gerd Keiser, "Optical Fiber Communication", 3rd Edition, McGraw Hill, 2000.
4. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.

REFERENCES

1. Robert E.Collin, "Foundations of Microwave Engineering",Mc Graw Hill, 2001.
2. Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill, 2004.
3. John Gowar, "Optical Communication Systems", Prentice Hall of India, 2001.
4. Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, "Optical Networks: A Practical Perspective", 3rd Edition, Morgan Kaufmann, 2010.
5. Govind P. Agrawal, "Fiber Optic Communication Systems", 3rd Edition, John Wiley &Sons, 2004.

E-REFERENCES

1. http://www.nptel.ac.in/downloads/117101054/
2. http://www.microwaves101.com
3. http://www.lightwaveonline.com

Mapping of COs with POs:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	1		1	2							1		1
CO 2	2	1		1	2							1		1
CO 3	2	1		1	2							1		1
CO 4	2	1		1	2							1		1
CO 5	2	1		1	2							1		1
Total	10	5		5	10							5		5
Scaled Value	2	1		1	2							1		1

COURSE CODE	XEC706	L	T	P	C
COURSE NAME	MICROWAVE ENGINEERING AND OPTICAL COMMUNICATION LAB	0	0	1	1
PREREQUISITES	Communication Theory	L	T	P	H
C: P: A	1:0:0	0	0	2	2

LEARNING OBJECTIVES

- To familiarize microwave components.
- To understand the operation and working microwave tube
- To enrich the knowledge on the measurement of various parameters of microwave systems.
- To explore the characteristics of microwave device
- To acquire the characteristics of optical sources and optical detectors

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Study*** the different types of microwave components	Cognitive Psycomotor	Mechanism Responding
CO2	***Demonstrate*** the characteristics of microwave tube	Cognitive Psycomotor	Mechanism Responding
CO3	***Demonstrate*** the characteristics of microwave device	Cognitive Psycomotor	Mechanism Responding
CO4	***Study*** the different microwave measurements and radiation pattern of antenna	Cognitive Psycomotor	Mechanism Responding
CO5	**Demonstrate** the characteristics of optical sources and optical detectors	Cognitive Psycomotor	Mechanism Responding

S.No.	List of Experiments	COs
	Microwave Engineering Experiments	
1	Study of E-Plane T, H-Plane T and Magic T, Isolator, Directional Coupler and Circulator	CO1
2	Characteristics of Reflex Klystron	CO2
3	Characteristics of Gunn Diode	CO3
4	VSWR, Frequency and Wave Length Measurement	CO4
5	Attenuation and Power measurement	CO4
6	Radiation Pattern and Gain of Antennas.	CO4
	Optical Communication Experiments	
7	Numerical Aperture Determination for Fiber	CO5
8	Measurement of Propagation Loss and Bending Loss in the Fiber	CO5
9	Analog Fiber Optic Communication Link	CO5
10	Fibre Optic Analog and Digital Links	CO5
11	VI characteristics of Fibre Optic LED.	CO5
12	VI characteristics of Photo Detector.	CO5

HOURS	PRACTICAL	TOTAL
	30	30

TEXT BOOKS

1. Samuel Y. Liao, “Microwave Devices & Circuits”, Prentice Hall of India, 2006.
2. John M. Senior, “Optical Fiber Communication”, 2nd Edition, Pearson Education, 2007.
3. Gerd Keiser, “Optical Fiber Communication”, 3rd Edition, McGraw Hill, 2000.
4. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.
5. Microwave test bench learning material 1.0 Nvis Technologies Pvt. Ltd., Indore.

REFERENCES

1. Robert E.Collin, “Foundations of Microwave Engineering”,Mc Graw Hill, 2001.
2. Annapurna Das and Sisir K Das, “Microwave Engineering”, Tata McGraw Hill, 2004.
3. John Gowar, “Optical Communication Systems”, Prentice Hall of India, 2001.
4. Rajiv Ramaswami, Kumar Sivarajan, Galen Sasaki, “Optical Networks: A Practical Perspective”, 3rd Edition, Morgan Kaufmann, 2010.
5. Govind P. Agrawal, “Fiber Optic Communication Systems”, 3rd Edition, John Wiley &Sons, 2004.

E-REFERENCES

1. http://www.nptel.ac.in/downloads/117101054/
2. http://www.microwaves101.com
3. http://www.lightwaveonline.com

Mapping of COs with POs:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	2	1		2	2				2	2		1		1
CO 2	2	1		2	2				2	2		1		1
CO 3	2	1		2	2				2	2		1		1
CO 4	2	1		2	2				2	2		1		1
CO 5	2	1		2	2				2	2		1		1
Total	10	5		10	10				10	10		5		5
Scaled Value	2	1		2	2				2	2		1		1

COURSECODE			XECM03	L	T	P	C
COURSE NAME			MATLAB FOR WIRELESS COMMUNICATION	0	0	0	0
PREREQUISITES			XEC602	L	T	P	H
C	P	A					
0	0	0		0	0	2	2

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Represent*** various blocks of wireless communication as a programme and ***show*** that simulation results are same as theoretical.	Cognitive Psychomotor	Understand Set

UNIT I	5+0+10

Simulation of a simple communication system and estimation bit error rate- BPSK, QPSK, QAM Modulation - Raised cosine pulses - AWGN channel - oversampled integrate-and-dump receiver front-end - Bit-error rate as a function of Es/N0 and oversampling rate. Rayleigh and Rician fading - Channel simulation - BER computation - passband and baseband systems - usage of baseband and advantages. Introduction to OFDM -Single-Carrier vs. Multi-Carrier Transmission - Basic Principle of OFDM OFDM Modulation and Demodulation - OFDM Guard Interval - OFDM Guard Band - BER of OFDM Scheme

	LECTURE	PRACTICAL	TOTAL
	5	10	15

TEXT BOOKS

1. Yong Soo Cho et al.,"MIMO-OFDM wireless communications with MATLAB", John Wiley & Sons (Asia) Pte Ltd, 2 Clementi Loop, # 02-01, Singapore 129809, 2010.\
2. Dennis Silage, "Digital Communication Systems Using MATLAB and Simulink, 2e, Bookstand Publishing, 2016

COURSE CODE			XEC505A	L	T	P	C
COURSE NAME			MEDICAL ELECTRONICS	3	0	0	3
PREREQUISITES			XEC304	L	T	P	H
C	P	A	3:0:0	3	0	0	3

LEARNING OBJECTIVES

- To impart the knowledge on the various physiological parameters , methods of recording and the methods of transmitting these parameters
- To introduce the various assist devices used in the hospitals
- To emphasis the students with the equipment used for physical medicine and therapeutic techniques.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** and ***explain*** the basics of the biomedical signals and associated recording instrumentation	Cognitive	Remembering Understanding
CO2	***Describe*** and ***understand*** the methods of measuring of bio-chemical and non electrical parameters	Cognitive	Remembering Understanding
CO3	***Describe*** and ***discuss*** the assist devices and bio-telemetry	Cognitive	Remembering Understanding
CO4	***Understand and categorize*** the principles of radiological equipment	Cognitive	Understanding Analyzing
CO5	***Explain*** the various diagnostic and therapeutic equipment and electrical safety	Cognitive	Understanding

UNIT I - ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING	**(9 Hours)**
Sources of bio medical signals, Bio-potentials, Bio-potential electrodes, biological amplifiers, ECG,EEG, EMG, PCG, typical waveforms and signal characteristics.	
UNIT II - BIO-CHEMICAL AND NON ELECTRICAL PARAMETERMEASUREMENT	**(9 Hours)**
pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, Temperature and pulse measurement, Blood Cell Counters.	
UNIT III - ASSIST DEVICES AND BIO-TELEMETRY	**(9 Hours)**
Cardiac pacemakers, DC Defibrillator, Telemetry principles, frequency selection, Bio-telemetry, radio-pill and tele-stimulation.	
UNIT IV - RADIOLOGICAL EQUIPMENTS	**(9 Hours)**
Ionizing radiation, Diagnostic X-ray equipments, use of Radio Isotope in diagnosis, Radiation Therapy.	
UNIT V - DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS AND ELECTRICAL SAFETY	**(9 Hours)**
Thermograph, Endoscopy unit, Laser in medicine, Diathermy units, Electrical safety in medical equipment.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Leislie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2002.

REFERENCES

1. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 1997.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, 1997.

E-REFERENCES

1. http://mx.nthu.edu.tw/~yucsu/3271/p07.pdf

COURSE CODE			XEC505B	L	T	P	C
COURSE NAME			COMMUNICATION NETWORKS	3	0	0	3
PREREQUISITES							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To impart the knowledge on the division of network functionalities into layers.
- To familiarize the components required to build different types of networks
- To expose the students on the required functionality at each layer
- To enhance the fundamental knowledge on the flow control and congestion control algorithms

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Define and Identify the components required to build different types of networks	Cognitive	Remembering Applying
CO2	Choose the required functionality at each layer for given application	Cognitive	Understanding Applying
CO3	Explain and define the routing concept	Cognitive	Remembering Evaluating
CO4	Define and Identify solution for each functionality at each layer	Cognitive	Remembering Applying
CO5	Explain and Trace the flow of information from one node to another node in the network	Cognitive	Remembering Applying

UNIT I - FUNDAMENTALS & LINK LAYER	**(9 Hours)**
Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction	
UNIT II - MEDIA ACCESS & INTERNET WORKING	**(9 Hours)**
Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP)	
UNIT III - ROUTING	**(9 Hours)**
Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6	
UNIT IV - TRANSPORT LAYER	**(9 Hours)**
Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements	
UNIT - V APPLICATION LAYER	**(9 Hours)**
Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls.	

	LECTURE	**PRACTICAL**	**TOTAL**
HOURS	**45**	**0**	**45**

TEXT BOOKS

1. Behrouz A. Forouzan, ―Data communication and Networking‖, Fifth Edition, Tata McGraw – Hill, 2013 (UNIT I –V)

REFERENCES

1. James F. Kurose, Keith W. Ross, ―Computer Networking - A Top-Down Approach Featuring the Internet‖, Seventh Edition, Pearson Education, 2016.

2. Nader. F. Mir,― Computer and Communication Networks‖, Pearson Prentice Hall Publishers, 2nd Edition, 2014.

3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, ―Computer Networks: An Open Source Approach‖, Mc Graw Hill Publisher, 2011.

4. Larry L. Peterson, Bruce S. Davie, ―Computer Networks: A Systems Approach‖, Fifth Edition, Morgan Kaufmann Publishers, 2011.

COURSE CODE			XEC505C	L	T	P	C
COURSE NAME			NANOTECHNOLOGY AND APPLICATIONS	3	0	0	3
PREREQUISITES							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To instill the knowledge of students on nanoscience and nanotechnology
- To expose the students on the basics of nanomaterial synthesis and characterization.
- To enhance the knowledge of the students on the applications of nanotechnology

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Describe the basic science behind the properties of materials.	Cognitive	Understanding
CO2	Interpret the creation, characterization, and manipulation of nanoscale materials.	Cognitive	Understanding
CO3	Describe and explain the nano structures	Cognitive	Understanding
CO4	Comprehend the exciting applications of nanotechnology at the leading edge of scientific research	Cognitive	Understanding
CO5	Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.	Cognitive	Understanding Applying

UNIT I - INTRODUCTION TO NANOTECHNOLOGY	**(9 Hours)**
Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bio nano-particles.	
UNIT II - FABRICATION AND CHARACTERIZATION OF NANOMATERIALS	**(9 Hours)**
Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.	
UNIT III - PROPERTIES AND MEASUREMENT OF NANOMATERIALS	**(9 Hours)**
Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.	
UNIT IV - NANO STRUCTURES	**(9 Hours)**
Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magneto resistance, etc. Cells response to Nanostructures.	
UNIT V - APPLICATIONS OF NANOTECHNOLOGY	**(9 Hours)**
Nano electronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)

2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)

REFERENCES

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.

2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.

3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

COURSE CODE			XEC604A	L	T	P	C
COURSE NAME			SWITCHING THEORY	3	0	0	3
PREREQUISITES			XEC404	L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To develop an understanding of the concepts of Frequency and Time division multiplexing.
- To introduce the concepts of space switching, time switching and combination switching.
- To provide exposure to the students on blocking probability holding service time distributions for in speech and data networks.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** the operational characteristics of switching techniques.	Cognitive	Remembering
CO2	***Outline*** the working principle of different Switching types and ***Explain*** the working the SONET Multiplexing	Cognitive	Remembering, Understanding
CO3	*D**escribe*** **and** ***Analyze*** the working concept of Digital Subscriber Access	Cognitive	Remembering, Understanding
CO4	***Compare*** **and** ***Discuss*** the operational characteristics of switching techniques.	Cognitive	Remembering, Understanding
CO5	***Analyze*** the traffic characterization of switching networks.	Cognitive	Analyzing

UNIT I - MULTIPLEXING **(9 Hours)**

Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing: Pulse Transmission, Line Coding, Binary N-Zero Substitution, Digital Biphase, Differential Encoding, Time Division Multiplexing, Time Division Multiplex Loops and Rings. SONET/SDH: SONET Multiplexing Overview, SONET Frame Formats, SONET Operations.

UNIT II -DIGITAL SWITCHING **(9 Hours)**

Switching Functions, Space Division Switching, Time Division Switching, two-dimensional Switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment. Elements of SSN07 signalling.

UNIT III - NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT	(9 Hours)
Timing: Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.	
UNIT IV - DIGITAL SUBSCRIBER ACCESS	**(9 Hours)**
ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, and Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.	
UNIT V - TRAFFIC ANALYSIS	**(9 Hours)**
Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOK

1. V.S.Bagad, "Telecommunication Switching and Networks", First Edition, Technical Publications Pune, January 2014.
2. P. Gnanasivam, "Telecommunication Switching and Networks", New Age International, 2005.
3. T.Viswanathan, Manav Bhatnagar, "Telecommunication Switching Systems and Networks", Prentice Hall of India, 2015.
4. Bellamy John, "Digital Telephony", 3rd Edition, John Wiley & Sons, 2000.

REFERENCES

1. J.E. Flood, "Telecommunication Switching, Traffic and Networks", Second Edition, Pearson Education 2007.

E-REFERENCES

1. http://www.nptel.ac.in/downloads/117105076/
2. http://www.bput.ac.in/lecture_notes/Digital%20switching%20and%20telecom%20network%20_PEEC5404_7TH%20SEMESTER_ETC.pdf

COURSE CODE			XEC604B	L	T	P	C
COURSE NAME			CMOS ANALOG IC DESIGN	3	0	0	3
PREREQUISITES							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To emphasis the students with the fundamentals of analog circuits and MOS device models
- To equip the students on various configurations of MOS transistors and feedback concepts
- To provide exposure to the students on the characteristics of noise and frequency response of the amplifier
- To impart the knowledge on the concepts of Op-Amp frequency compensation, capacitor switches and PLLs

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Realize the concepts of Analog MOS devices and current mirror circuits.	Cognitive	Remembering
CO2	Design different configuration of Amplifiers and feedback circuits.	Cognitive	Understanding
CO3	Analyze the characteristics of frequency response of the amplifier and its noise.	Cognitive	Analysing
CO4	Analyze the performance of the stability and frequency compensation techniques of OpAmp Circuits.	Cognitive	Analysing
CO5	Construct switched capacitor circuits and PLLs	Cognitive	Applying

UNIT I - INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS	(9 Hours)
Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors Active current mirrors- Large and Small signal analysis- Common mode properties.	
UNIT II - AMPLIFIERS AND FEEDBACK	**(9 Hours)**
Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.	
UNIT III - FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE	**(9 Hours)**
General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.	
UNIT IV - OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION	**(9 Hours)**
General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps General consideration of stability and frequency compensation- Multipole system- Phase margin Frequency compensation- Compensation of two stage op Amps- Other compensation techniques.	

UNIT V - SWITCHED CAPACITOR CIRCUITS AND PLLS	(9 Hours)

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
HOURS	45	0	0	45

TEXT BOOKS

1. Behzad Razavi, ―Design of Analog CMOS Integrated Circuits‖, Tata McGraw Hill, 2001, 33rd re-print, 2016.

REFERENCES

1. Phillip Allen and Douglas Holmberg ―CMOS Analog Circuit Design‖ Second Edition, Oxford University Press, 2004.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009
3. Grebene, ―Bipolar and MOS Analog Integrated circuit design‖, John Wiley & sons, Inc., 2003.

COURSE CODE	XEC604C	L	T	P	C
COURSE NAME	STATISTICAL THEORY OF COMMUNICATION	3	0	0	3

PREREQUISITES							
C	**P**	**A**		L	T	P	H
3	**0**	**0**		**3**	**0**	**0**	**3**

LEARNING OBJECTIVES

- To enhance the fundamental knowledge on manipulating linear data structures
- To acquaint the students on manipulating nonlinear data structures
- To expose the students to manipulate sorting techniques
- To acquaint the students to manipulate graph algorithms
- To educate the students with the algorithm and design techniques

COURSE OUTCOMES		**DOMAIN**	**LEVEL**
CO1	To know, ***analyze, apply*** and manipulate linear data structures	Cognitive	Understanding Analysing Applying
CO2	To know, ***analyze, apply*** and manipulate nonlinear data structures	Cognitive	Understanding Analysing Applying
CO3	To know, ***analyze, apply*** and manipulate sorting techniques	Cognitive	Understanding Analysing Applying
CO4	To know, ***analyze, apply*** and manipulate graph algorithms	Cognitive	Understanding Analysing Applying
CO5	To know and ***analyze*** algorithm design techniques.	Cognitive	Understanding Analysing Applying

UNIT I - CLASSICAL DETECTION AND ESTIMATION THEORY	**(9 Hours)**

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

UNIT II - REPRESENTATIONS OF RANDOM PROCESSES	**(9 Hours)**

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

UNIT III - DETECTION OF SIGNALS – ESTIMATION OF SIGNAL PARAMETERS	(9 Hours)
Detection and Estimation in White Gaussian and Non-White Gaussian noise – Signals with unwanted parameters: The Composite hypothesis problem – Multiple channels – Multiple parameter estimation.	
UNIT IV - ESTIMATION OF CONTINUOUS WAVEFORMS	**(9 Hours)**
Derivation of Estimator equations – A Lower bound on the mean square estimation error – Multidimensional waveform estimation – Non random waveform estimation.	
UNIT V - LINEAR ESTIMATION	**(9 Hours)**
Properties of Optimum processors – Realizable Linear filters: Stationary processes, Infinite past: Wiener filters – Kalman-Bucy filters – Linear Modulation: Communications context - Fundamental role of the Optimum linear filter.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
HOURS	45	0	0	45

TEXT BOOKS

1. Harry L. Van Trees, "Detection, Estimation and Modulation theory"– Part I/ Edition 2, John Wiley & Sons, NY, USA, 2013.

2. P. Eugene Xavier, "Statistical theory of Communication", New Age International Ltd. Publishers, New Delhi, 2007.

REFERENCES

1. Prof. B.R. Levin, " Statistical communication theory and its applications", MIR Publishers, Moscow, 1982.

COURSE CODE			XEC702A	L	T	P	C
COURSE NAME			FUNDAMENTALS OF DATA STRUCTURES IN C	3	0	0	3
PREREQUISITES							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To familiarize the students on the features of C
- To impart the knowledge to the students on the linear and non-linear data structures
- To teach the students about the applications of linear and non-linear data structures
- To enhance the fundamental knowledge of students to represent data using graph data structure
- To educate the students with the basic sorting and searching algorithms

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Implement linear and non-linear data structure operations using C	Cognitive	Understanding
CO2	Suggest appropriate linear / non-linear data structure for any given data set.	Cognitive	Remembering
CO3	Apply hashing concepts for a given problem	Cognitive	Applying
CO4	Modify or suggest new data structure for an application	Cognitive	Creating
CO5	Appropriately choose the sorting algorithm for an application	Cognitive	Applying

UNIT I - C PROGRAMMING BASICS **(9 Hours)**

Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. Strings- String operations – String Arrays. Simple programs- sorting searching – matrix operations.

UNIT II - FUNCTIONS, POINTERS, STRUCTURES AND UNIONS **(9 Hours)**

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

UNIT III - LINEAR DATA STRUCTURES **(9 Hours)**

Arrays and its representations – Stacks and Queues – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

UNIT IV - NON-LINEAR DATA STRUCTURES **(9 Hours)**

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Set representations - Union-Find operations. Graph and its representations – Graph Traversals.

UNIT V - SEARCHING AND SORTING ALGORITHMS **(9 Hours)**

Linear Search – Binary Search. Bubble Sort, Insertion sort – Merge sort – Quick sort - Hash tables – Overflow handling.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Pradip Dey and Manas Ghosh, ―Programming in C, Second Edition, Oxford University Press, 2011. 2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

REFERENCES

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996.

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, 1983.

3. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla , ― Data Structures and Program Design in C, Second Edition, Pearson Education, 2007

4. Jean-Paul Tremblay and Paul G. Sorenson, ―An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

COURSE CODE	XEC702B	L	T	P	C

COURSE NAME			ROBOTICS AND AUTOMATION	3	0	0	3
PREREQUISITES							
C	P	A		L	T	P	H
3	0	0		3	0	0	3

LEARNING OBJECTIVES

- To educate the students with design, function, applications and robots
- To emphasis the students with the electrical drive systems and sensors used in robots
- To expose the students about analyzing robot kinematics, dynamics and design aspects of robot arm manipulator
- To acquaint the students with the various motion planning techniques and the associated control architecture
- To impart the knowledge on the implications of AI and other trending concepts of robotics

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Explain the classification , need and application of robots.	Cognitive	Understanding Analysing
CO2	Examine different sensors and actuators for applications like maze solving and self driving cars.	Cognitive	Understanding Analysing
CO3	Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots.	Cognitive	Understanding Analysing
CO4	Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.	Cognitive	Understanding Analysing
CO5	Describe the impact and progress in AI and other research trends in the field of robotics.	Cognitive	Understanding Analysing

UNIT I - FOUNDATION FOR BEGINNERS	(9 Hours)

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT II - BUILDING BLOCKS OF A ROBOT	(9 Hours)

Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars.

UNIT III - KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS	(9 Hours)

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study.

UNIT IV - NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE	(9 Hours)

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT V - AI AND OTHER RESEARCH TRENDS IN ROBOTICS	(9 Hours)

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002.
2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2011.

REFERENCES

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.
5. Robin Murphy, Introduction to AI Robotics, MIT Press, 2000
6. Ronald C. Arkin, Behavior-based Robotics, MIT Press, 1998
7. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, Evolutionary Robotics – The Biology, Intelligence and Technology of Self–Organizing Machines (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004.

COURSE CODE	XEC702C	L	T	P	C

COURSE NAME			INTERNET OF THINGS	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To enhance the fundamental knowledge on various IoT related technologies.
- To acquaint the students with the resource management in IoT.
- To emphasis the students with the various architecture, platforms, services of IoT.
- To educate the students with the integration of IoT to IP
- To impart the knowledge on various IoT applications.

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	***Describe*** Internet of Thins (IoT) and *explain* various IoT related technologies.	Cognitive	Remembering, Understanding
CO2	***Describe*** resource management in IoT.	Cognitive	Remembering
CO3	***Describe*** and ***distinguish*** various architecture, platforms, services of IoT.	Cognitive	Remembering, Understanding
CO4	***Explain*** how IoT can be integrated to IP.	Cognitive	Understanding
CO5	***Describe*** various IoT applications.	Cognitive	Remembering

UNIT - I INTRODUCTION AND ENABLING TECHNOLOGIES IN IOT **(9 Hours)**

IoT, Machine to Machine, Web of Things, Definition- Major components if IoT devices-Control Units-Sensors-Communication Modules-Power Sources Vision- Characteristics - Layered Architecture- Landscape-- IoT Functional View-IoT related Internet Technology-cloud computing-Networks and Communications related to IoT-Processes related to IoT-Data Management related to IoT-Security Privacy and Trust-Devices level energy issues-Standards related to IoT.

UNIT - II RESOURCE MANAGEMENT IN THE INTERNET OF THINGS **(9 Hours)**

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects.

UNIT - III THE ARCHITECTURE, PLATFORMS, SERVICES	(9 Hours)
The Layering concepts , IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN, Platforms - IBM watson-Intel Platform- Carriot Platform- Webnms-device WISE.	
UNIT - IV SCALABLE INTEGRATION FRAMEWORK	**(9 Hours)**
Introduction- IPV6 Potential- IoT6- IPV6 for IoT- Adapting IPV6 to IoT requirement- IoT6 architecture - DigCovery- IoT6 Integration with cloud and EPICS- Enabling Heterogeneous Integration- IoT6 Smart Office use case- Scalability perceptive.	
UNIT - V IOT APPLICATIONS	**(9 Hours)**
Smart Environments and Smart Space creation - Connected Devices illustration-Industrial IoT-IERC application Domains-Smart Environment Monitoring- Smart Energy - Smart building-Smart Transport and mobility-IoT Smart X applications.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
HOURS	45	0	0	45

TEXT BOOKS

1. Ovidiu Vermesan, Peter Friess, "Internet of Things- From Research and Innovation to market Deployment", River Publishers, 2014.

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti Internet of Things: A Hands-On Approach Hardcover – Madisetti Publishers, 2014
2. Samuel Greengard, "The Internet of Things", MIT Press, 2015.

E REFERENCES

1. http://postscapes.com/internet-of-things-resources/

COURSE CODE	XEC703A	L	T	P	C
COURSE NAME	WIRELESS COMMUNICATION	3	0	0	3

PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To enhance the fundamental knowledge on the characteristic of wireless channel
- To acquaint the students with the design of a cellular system
- To expose the students on various digital signaling techniques and multipath mitigation techniques
- To educate the students with the concepts of multiple antenna techniques

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Characterize a wireless channel and evolve the system design specifications.	Cognitive	Understanding
CO2	Design a cellular system based on resource availability and traffic demands.	Cognitive	Remembering
CO3	Explain keying technics.	Cognitive	Understanding Applying
CO4	Identify suitable signalling and multipath mitigation techniques.	Cognitive	Understanding Applying
CO5	Identify for the multiple antenna technics wireless channel and system under consideration.	Cognitive	Understanding Applying

UNIT - I WIRELESS CHANNELS **(9 Hours)**

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

UNIT - II CELLULAR ARCHITECTURE **(9 Hours)**

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

UNIT - III DIGITAL SIGNALING FOR FADING CHANNELS **(9 Hours)**

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

UNIT - IV MULTIPATH MITIGATION TECHNIQUES **(9 Hours)**

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

UNIT - V MULTIPLE ANTENNA TECHNIQUES	(9 Hours)

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

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Rappaport,T.S., ―Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, ―Wireless Communications‖, John Wiley – India, 2006. (UNIT III,V)

REFERENCES

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011.
2. Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000.
3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Upena Dalal, ―Wireless Communication‖, Oxford University Press, 2009.

COURSE CODE	XEC703B	L	T	P	C
COURSE NAME	WIRELESS NETWORKS	3	0	0	3

PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To impart the knowledge on the concept of wireless networks, protocol stack and standards
- To educate the students with the network layer solutions for wireless networks
- To enhance the fundamental knowledge on 3G Services, its protocols and applications
- To emphasis the students on internetworking of WLAN and WWAN
- To teach the evolution of 4G Networks, its architecture and applications

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Conversant with the latest 3G/4G networks and its architecture.	Cognitive	Remembering
CO2	Design and implement wireless network environment for any application using latest wireless protocols and standards.	Cognitive	Understanding
CO3	Ability to select the suitable network depending on the availability and requirement.	Cognitive	Remembering, Analysis
CO4	Explain and describe WLANS and WWANS.	Cognitive	Understanding
CO5	Implement different type of applications for smart phones and mobile devices with latest network strategies.	Cognitive	Understanding

UNIT - I WIRELESS LAN **(9 Hours)**

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART.

UNIT - II MOBILE NETWORK LAYER **(9 Hours)**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT - III 3G OVERVIEW **(9 Hours)**

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV - INTERNETWORKING BETWEEN WLANS AND WWANS **(9 Hours)**

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT - V 4G & Beyond **(9 Hours)**

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2012.(Unit I,II,III).
2. Vijay Garg, ―Wireless Communications and networking‖, First Edition, Elsevier 2007. (Unit IV,V).

REFERENCES

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, ―Wireless Networking‖, First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, ―Modern Wireless Communications‖, First Edition, Pearson Education 2013.

COURSE CODE	XEC703C	L	T	P	C

COURSE NAME			AD HOC AND WIRELESS SENSOR NETWORKS	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To enhance the fundamental knowledge on Ad hoc network and Sensor Network.
- To illustrate the different routing protocols
- To create awareness on sensor network architecture and design issues
- To expose the students on the transport layer and security issues possible in Ad hoc and Sensor networks
- To provide thorough understanding on remote programming platforms and tools

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks.	Cognitive	Understanding Applying
CO2	Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.	Cognitive	Understanding Applying
CO3	Apply the knowledge to identify appropriate physical and MAC layer protocols.	Cognitive	Understanding Applying
CO4	Understand the transport layer and security issues possible in Ad hoc and sensor networks.	Cognitive	Understanding Applying
CO5	Be familiar with the OS used in Wireless Sensor Networks and build basic modules.	Cognitive	Understanding Applying

UNIT I – AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS. (9 Hours)

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

UNIT II - SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES (9 Hours)

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT III - WSN NETWORKING CONCEPTS AND PROTOCOLS (9 Hours)

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT IV - SENSOR NETWORK SECURITY	(9 Hours)
Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.	
UNIT V - SENSOR NETWORK PLATFORMS AND TOOLS	**(9 Hours)**
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. C. Siva Ram Murthy and B. S. Manoj, ―Ad Hoc Wireless Networks Architectures and Protocols‖, Prentice Hall, PTR, 2004. (UNIT I).
2. Holger Karl , Andreas willig, ―Protocol and Architecture for Wireless Sensor Networks‖, John wiley publication, Jan 2006.(UNIT II-V).

REFERENCES

1. Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks: an information processing approach‖, Elsevier publication, 2004.
2. Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ―Wireless sensor networks: a survey‖, computer networks, Elsevier, 2002, 394 - 422.

COURSE CODE			XEC801A	L	T	P	C
COURSE NAME			PRINCIPLES OF SPEECH PROCESSING	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To acquaint the students with the speech production mechanism and the various speech analysis techniques and speech models
- To expose the students on the speech compression techniques
- To educate the students with the speech recognition techniques
- To develop an understanding of the basic concepts of speaker recognition systems
- To emphasis the students with the text to speech synthesis techniques

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Design speech compression techniques	Cognitive	Understanding, Applying
CO2	Configure speech compression techniques	Cognitive	Understanding, Applying
CO3	Configure speech recognition techniques	Cognitive	Understanding, Applying
CO4	Design speaker recognition systems	Cognitive	Understanding, Applying
CO5	Design text to speech synthesis systems	Cognitive	Understanding, Applying

UNIT I - SPEECH SIGNAL CHARACTERISTICS & ANALYSIS **(9 Hours)**

Speech production process - speech sounds and features- - Phonetic Representation of Speech -- representing= speech in time and frequency domains - Short-Time Analysis of Speech – Short Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception.

UNIT II - SPEECH COMPRESSION **(9 Hours)**

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP).

UNIT III - SPEECH RECOGNITION **(9 Hours)**

LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM- subword unit model based on HMM- language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition.

UNIT IV - SPEAKER RECOGNITION	(9 Hours)
Acoustic parameters for speaker verification- Feature space for speaker recognition-similarity measures- Text dependent speaker verification-Text independent speaker verification techniques.	
UNIT V - SPEAKER RECOGNITION AND TEXT TO SPEECH SYNTHESIS	**(9 Hours)**
Text to speech synthesis(TTS)-Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. L. R. Rabiner and R. W. Schafer, Introduction to Digital Signal Processing, Foundations and Trends in Signal Processing Vol. 1, Nos. 1–2 (2007) 1–194.

2. Ben Gold and Nelson Morgan ―Speech and Audio signal processing- processing and perception of speech and music‖, John Wiley and sons 2006.

REFERENCES

1. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana ―Fundamentals of Speech Recognition‖, Pearson Education, 2009.

2. Claudio Becchetti and Lucio Prina Ricotti, ―Speech Recognition‖, John Wiley and Sons, 1999.

3. Donglos O shanhnessy ―Speech Communication: Human and Machine ―, 2nd Ed. University press 2001.

COURSE CODE			XEC801B	L	T	P	C
COURSE NAME			MULTIMEDIA COMPRESSION AND COMMUNICATION	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To impart the knowledge on the compression schemes for text, voice, image and video
- To enhance the fundamental knowledge on Configure Text, image and video compression techniques
- To educate the students with the QoS issues in multimedia network
- To emphasis the students with the communication protocols for multimedia networking

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Design audio compression techniques	Cognitive	Understanding Applying
CO2	Configure Text, image and video compression techniques	Cognitive	Understanding Applying
CO3	Describe text compression techniques	Cognitive	Understanding Applying
CO4	Select suitable service model for specific application	Cognitive	Remembering Applying
CO5	Configure multimedia communication network	Cognitive	Understanding Applying

UNIT I - AUDIO COMPRESSION **(9 Hours)**

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP).

UNIT II - IMAGE AND VIDEO COMPRESSION **(9 Hours)**

Graphics Interchange format- Tagged image file format-Digitized documents- Digitized pictures JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2.

UNIT III - TEXT COMPRESSION **(9 Hours)**

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding.

UNIT IV - GUARANTEED SERVICE MODEL	(9 Hours)

Best Effort service model – Scheduling and Dropping policies – Network Performance Parameters – Quality of Service and metrics – WFQ and its variants – Random Early Detection – QoS aware Routing – Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms – Caching – Laissez Faire Approach - Possible Architectures – An Overview of QoS Architectures.

UNIT V - MULTIMEDIA COMMUNICATION	(9 Hours)

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter – Fixed playout and Adaptive playout – Recovering from packet loss – RTSP — Multimedia Communication Standards – RTP/RTCP – SIP and H.263.

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Fred Halsall, - Multimedia communication- Applications, Networks, Protocols and Standards‖, Pearson education, 2007.

REFERENCES

1. Tay Vaughan, ―Multimedia Making it work , McGraw-Hill Osborne Media, 2006.
2. Kurose and W. Ross, ―Computer Networking ―A Top Down Approach, Pearson education, 3rd ed, 2005.
3. KR. Rao,Z S Bojkovic, D A Milovanovic, ―Multimedia Communication Systems: Techniques, Standards, and Networks‖, Pearson Education 2007
4. R. Steimnetz, K. Nahrstedt, ―Multimedia Computing, Communications and Applications‖, Pearson Education, First ed, 1995.
5. Nalin K Sharda, _Multimedia Information Networking‘, Prentice Hall of India, 1999
6. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, _Multimedia Wireless Networks: Technologies, Standards and QoS‘, Prentice Hall, 2003.
7. Ellen Kayata Wesel, _Wireless Multimedia Communications: Networking Video, Voice and Data‘, Addision Wesley, 1998.

COURSE CODE			XEC801C	L	T	P	C
COURSE NAME			DIGITAL IMAGE PROCESSING	3	0	0	3
PREREQUISITES				L	T	P	H
C	P	A		3	0	0	3
3	0	0					

LEARNING OBJECTIVES

- To equip the students with digital image fundamentals
- To provide exposure to the students on simple image enhancement techniques in Spatial and Frequency domain.
- To educate the students with the degradation function and restoration techniques.
- To emphasis the students with the image segmentation and representation techniques.
- To expose the students on image compression and recognition methods

COURSE OUTCOMES		DOMAIN	LEVEL
CO1	Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.	Cognitive	Understanding Applying
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement.	Cognitive	Understanding Applying
CO3	Understand the restoration concepts and filtering techniques.	Cognitive	Understanding Applying
CO4	Learn the basics of segmentation, features extraction.	Cognitive	Remembering Applying
CO5	Learn the compression and recognition methods for color models.	Cognitive	Remembering Applying

UNIT I - DIGITAL IMAGE FUNDAMENTALS **(9 Hours)**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II - IMAGE ENHANCEMENT **(9 Hours)**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III - IMAGE RESTORATION	(9 Hours)
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.	
UNIT IV - IMAGE SEGMENTATION	**(9 Hours)**
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	
UNIT V - IMAGE COMPRESSION AND RECOGNITION	**(9 Hours)**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.	

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, _Digital Image Processing‘, Pearson, Third Edition, 2010.
2. Anil K. Jain, _Fundamentals of Digital Image Processing‘, Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, _Digital Image Processing‘, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, _Digital Image Processing using MATLAB‘, Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, _Multidimensional Digital Signal Processing‘, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, _Digital Image Processing‘, John Wiley, New York, 2002
5. Milan Sonka et al _Image processing, analysis and machine vision‘, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.